FINANCE COMMERCE ENGINEERING

THE FAR EASTERN REVIEW

上海黃浦灘念四號

遠東時報

UNSETTLED PROBLEMS OF THE FAR EAST

THE AIMS OF JAPAN

JAPANESE NAVAL POLICY

Vol. XXXI JULY, 1935 No. 7

Founded in 1885

150 Vessels **898,000 Gross Tons**

Wherever you go over the ocean, comfort and excellent courteous service are always assured by the N. Y. K.'s fast and modern liners cleaving the seven seas.

N. Y. K. Principal Passenger Services

Orient-California Service - - - -	Fortnightly
Orient-Seattle-Vancouver Service - - -	Fortnightly
Japan-Europe Service - - - - -	Fortnightly
Japan-Australia Service - - - - -	Monthly
Japan-South America (West Coast) Service -	Monthly
Japan-Bombay Service - - - - -	Monthly
Shanghai-Nagasaki-Kobe Rapid Express Service	Every 4 days

etc.

Various Round Trip Fares quoted on very economical and convenient basis

(Japan Mail)

Head Office: TOKYO, JAPAN
Shanghai Office: 31, THE BUND

Offices and Agencies throughout the World

General Passenger Agents, Cunard White Star Line in the Orient

The Far Eastern Review

ENGINEERING FINANCE COMMERCE

Vol. XXXI SHANGHAI, JULY, 1935 No. 7

Unsettled Problems of the Far East

By FRANCIS W. CLARKE

(The author, who is Assistant Editor of "The Constitution" was a Member of the party of prominent American Journalists sent to the Far East in 1929 by the Carnegie Endowment for International Peace)

The complexity of the problem faced by the occidental world in determining its attitude toward the fast-changing conditions in the Far East is emphasized in recent comment by three writers of world-wide renown—one a Japanese, one an Englishman and one an American.

The situation is viewed from radically divergent standpoints by Sir Frederick Whyte, outstanding British governmental leader, and Toshio Shiratori, former spokesman for Japan's Foreign Office and now minister to Sweden, but there is a strange and at the same time illuminating agreement in their comment on the attitude of the east toward the west.

The eastern mind, after a contact of a century or so with western civilization, which is termed "new" in comparison with the eastern civilization which came into existence many centuries ago, looks upon us now as children and treats us accordingly in the opinion of the European writer. Along the same line of reasoning, the Japanese diplomat feels that "the blind imitation of the west has to cease and there must be a cool and mature re-examination of the materialistic institutions of the west in the light of the idealism of the east, so that there may be evolved a distinct civilization hitherto not known."

In marked contrast to the belief expressed by these two writers that western civilization is unsuited for the east, or at least that the east will not accept it, is the position assumed by Frank H. Simonds, veteran American commentator on international affairs. In a recent article he points out, in effect, that Japan's great half century of expansion and development has been solely along occidental lines and that the acts for which she has been chiefly criticized by western nations are identical with similar steps taken by these same nations in the past.

Having accomplished such unprecedented progress by the adoption of western standards, it is obviously improbable that a people who have proved themselves as world-wise as have the Japanese will lend a willing ear to those who would have them attempt to turn back at least in part, to either the tenets or practices of the idealistic civilization of the east.

East Follows Traditions

Unquestionably Sir Frederick Whyte in his article, "The Mind of Asia," appearing in a recent issue of the *Atlantic Monthly*, colors his depiction of conditions in the Far East with those existing in India, where Great Britain is still struggling futilely against caste, family loyalty and the other age-old principles of an idealistic eastern civilization.

The east is still, in many respects, the east of bygone centuries, but the Far East has been permeated to the heart with at least a general knowledge of the workings of occidental civilization, largely through its energetic adoption by Japan. It must be borne in mind in considering the Asiatic situation as a whole, that there is no Japan in the east to act as a radical leader for the hundreds of millions of peoples living in that immense territory.

Because of his failure properly to take into consideration this difference between the East and the Far East, Sir Frederick is led to say that the prestige of the west has been shaken and that "throughout the Far East the most evident tendency to-day is to turn back on western culture and seek salvation once more in the ture oriental tradition."

No American commentator believes that this is the case. Japan is too wise to abandon the methods which have brought her from an obsolete country to one of the great powers of the world. It is certain that the development of the new state of Manchuokuo will be directed along occidental rather than oriental lines. Even in China proper, the most backward of the far eastern nations, the Kuomintang Government is driving for the development of the country along materialistic rather than idealistic lines.

Mr. Shiratori takes the position that Japan, heretofore looked upon as the meeting ground for old and modern civilizations, must play a higher rôle than that of a mere bridge or halfway house, and predicts that "not only will the east and west meet in Japan, but they shall meet and grow into a compact and coherent whole whose radiance shall brighten the remotest corners of the earth. That is the supreme mission of the new Japan."

This writer refers to a "re-awakening that is distinctly and vociferously in evidence throughout Japan," and terms it "an agitation for a thorough-going revision of the system of capitalistic liberalism with all that it has brought upon the life of the Japanese people."

Unrest Growing in Japan

Further along this line, Mr. Shiratori writes: "In Japan the unrest, political, social and economic has not in the least abated, and the feeling is general that the national crisis has only just begun, and that the worst is yet to come. It is averred that nothing short of a fundamental reorganization of the political and economic structure of the state will suffice to weather the storm."

Holding that the world has accused Japan of something of which she is innocent—aggression, as the term is understood in the capitalist and imperialist west—this Japanese leader admits that his people "are aware, now without compunction, that excesses have been committed both at home and on the continent; they are prepared for further annoying occurrences and developments; but all that is taken calmly as the inevitable throes attending the new birth which is taking place in Japan."

Mr. Simonds, although admitting the possibility of war between the United States and Japan unless cool counsel prevails in both nations, presents an impressive array of facts to prove that such an eventuality would result not from the existence of any fundamental differences of policy between the two countries, but, if it came, would be because of some preventable incident that would, as has happened so often in history, prove to be the spark that would set off a conflagration.

The American commentator feels that "the question that is posed by the Japanese issue is simple in the extreme. On the one hand, apart from the dubious advantage of supplying money and arms to the Chinese to enable them to attack the Japanese, no material interest of the United States is at stake. The Japanese are ready to give necessary assurances of the open door in China—in fact, they have repeatedly done so. Those guarantees have a present value at least, for Japanese interests are not seriously affected thereby. On the other hand, there is no blinking the fact that if we are resolved to play the rôle of international mentor and guarantor of the sanctity of treaties, there is no present possibility of composing our differences with Japan or escaping the constant possibility of war.

" What complicates the whole problem fatally is the widespread belief in America that it is possible to do something for righteousness safely—that we can, on the one hand, pursue a course in the Far East manifestly disastrous to Japanese interests, and, on the other, escape all unpleasant consequences of such action."

In the mind of this astute American observer of international affairs " in the Far East peace has a price for us, but the price does not seem excessive by comparison with the cost of war, and I, for one, am prepared to pay it. What terrifies me is the fashion in which the people who sincerely desire peace advocate national policies which can only lead to conflict."

Transition Still in Progress

So the story runs. Every spectator or commentator seems to have a different viewpoint on what is what in the economic and political transition that has been going on in the Far East during the past few decades and is still far from the end of its course.

Mr. Shiratori represents one of several schools of thought now active in Japan. That the nation is undergoing the throes of a re-arrangement of governmental and popular thought and viewpoint is undoubted. The uncertainty thus existing within a nation that is the keystone to the far eastern situation adds to the complexities of the whole problem.

A further complication is the misconception of the real facts that exists in the British mind, as evidenced by Sir Frederick Whyte's confusion of far eastern and eastern conditions.

The most hopeful aspect of the situation is to be found in the calm logic, as reflected by Mr. Simonds, with which most Americans now view our obligations and our inhibitions in the period of reconstruction going on across the Pacific.

It is inevitable that with the development of Japan into a great and powerful nation our part in the far east should become somewhat less important than the one we played when there was not great oriental nation. It is evidence of our good sportsmanship that we should now be willing, as we undoubtedly are, to grant to Japan the same influence in her part of the world that the United States demanded in the western hemisphere when this country, so to speak, came of age.

But of far greater importance, we should bear in mind the customary fate of the meddler. Certainly the United States has all to lose and nothing to gain by becoming involved in an objectionable way in a troubled situation that is, so far at least, little of out business.

Japan's Expanding Trade Causes World Crisis

The department of commerce of the United States and the corresponding agencies of the other great nations of the world are far more disturbed over the world-trade crisis brought about by the unprecedented expansion within the past decade or so than over the political situation in the Far East.

There is good reason for this. There is little doubt in any chancellery in the world that the far eastern problem so far as its governmental and racial phases are concerned, can be solved through wise diplomacy on a basis satisfactory to both Japan and the occidental world. But the threat to the pocket-books of the owners and workers in their industries presents a far more difficult situation and one fraught with the possibility of strained international relations out of which any eventuality, including war, might easily come.

Underneath the surface of the careful verbiage of diplomatic exchanges there is a conviction in all national capitals that it will not be difficult to reach a basis on which the governmental interests of every country can be safeguarded in the Far East. This is as true of Washington as it is of London or Paris.

This feeling arises out of the new universal realization that Japan, in her new status as a great power, is entitled to and should receive the same respect and consideration that the large occidental nations extend to each other. With that realization, combined with Japan's continuance, in most instances, in holding within reasonable bounds her demands for the recognition of increased rights, it is not surprising that there should be no real anxiety among western nations over their future relations with the Far East.

No United Front

In this respect Japan occupies a strategic position in view of the improbability of united action by the occidental nations against her. The likelihood is just the opposite, with each of the western nations exercising a keen watch to see that no other nation obtains a preferred position incident to the modernization of conditions in the eastern portion of the Asiatic continent. Undoubtedly it is far more probable that, so far as the political situation is concerned, the western nations will present a divided rather than a united front in the Far East. In such a situation, Japan would, of course, hold the favored position, being able to go about strengthening her own interests while her sister powers were busy keeping a wary eye on each other.

But no such favorable position will be Nippon's if the present world trade situation continues. If it does, a combination of the other exporting nations of the world in opposition to the threat of Japanese dominance of the richest markets on every continent is practically inevitable.

Nippon Not Self-Supporting

The chief ray of light in a gloomy situation exists in the hope that Japan will be wise enough to realize that in the long run she will be the loser if an end is not called to the cut-throat methods of competition now being used by some of her industrial leaders.

Japan in her new sphere as an industrial nation now occupies a position practically identical with that of England for a century or more. British prosperity is entirely dependent upon the well-being of her world trade and that is why Britain was for so-long a free trade nation. Neither England nor Japan is self-supporting from the standpoint of agriculture or mineral resources, and Japan, should she be forced out of the markets of the world, would be in the worst position of the two, since England could rely upon her dominions and Japan has none.

The solution of the problem through the erection of tariff walls will not be as simple or easy as it seems, because Japan has a powerful defensive weapon in the tremendous purchases of raw materials her industries are now making in the four corners of the universe. Forced out of the markets of the British empire, she can retaliate by discontinuing her purchases of Australian wool and hides, Indian cotton and Canadian wheat and lumber. Japan has superseded England as the principal buyer of American cotton, and she could deliver a blow to the southern states, through taking her patronage elsewhere, that would be felt in every line of industry in this country.

On the other side of the picture, Japan has only two great agricultural products that she exports—silk and tea—and the United States purchases approximately 90 per cent of one and 80 per cent of the other.

In these intricate and complicated phases of world trade lies the hope held in Washington and other capitals of the world that a country which has proved itself so wise in the planning and execution of its marvellous industrial expansion along the lines of western civilization will realize the inevitable destructive results of a campaign to undersell the rest of the world in major types of manufactured commodities.

Undersell Other Producers

Back of the success with which Japanese goods have met during the past five to ten years in a constantly expanding world market is the fact that Japanese manufacturers have been able to manufacture and sell their wares at prices that would be ruinous to the industries of other countries.

They have been able to do this, it was pointed out in a recent interview with Ambassador Saito largely because Japanese industrialists make a habit of buying their raw material in low markets and selling their finished products in high markets. This has been possible, because, while the industry of the rest of the world has slumped during the depression, that of Japan has been booming. Japanese merchants have been able to bide their time until the materials they required hit rock-bottom prices and then place their products on markets which brought them good profits, although the prices they have charged have been far less than those placed on American, British and other European products of similar nature.

Temporary Condition

Undoubtedly this ability to buy cheap and sell comparatively high has had much to do with the success of Japanese industrialists in under-selling their competitors and if this were the only reason for the cheaper prices of articles made in Japan there would be no cause for world concern. It is, however, a purely temporary condition made possible by the fact that Japanese industry has been prosperous while that of the rest of the world has been hard hit by the depression, a condition that can be rectified, and undoubtedly will, when normal economic conditions return.

Of far more serious import is the charge of western manufacturers that they cannot meet the prices of the products manufactured in the new industrial nation of the Far East because the living standards of American and European labor make it necessary for them to pay higher wages than are paid by the Nipponese manufacturers.

To this the Japanese reply that the living standards of their working classes at least so far as industrial workers are concerned, are no lower than those of other nations. A clear interpretation of this position is contained in a recent article by Mr. Kawakami, in *Foreign Affairs*, the official organ of the Council of Foreign Affairs.

Difference in Standards

Mr. Kawakami, whose ability and long residence in the United States have won him high rank among the commentators on our relations with the Far East, writes that " much nonsense has been talked about the Japanese standard of living as compared with the western standard. The truth is that there is no higher or lower, no superior or inferior standard of living as between Japan and the west. The question is simply one of difference. Transplant a Japanese mill hand to Lancashire, give him an iron bed with a soft mattress, put him on a ration of bread and butter, beefsteak, coffee and cream, and he will go on a strike, demanding Japanese bedding spread on a matted floor, and a ration of fish, rice and vegetables which, to him are more palatable and wholesome. It is the misfortune of the British or American that his standard calls for higher-price materials than the Japanese, that is all."

This Japanese writer further points out that the unusual ability of Japanese craftsmen to improve various types of machinery used in other countries has enabled them to reduce overhead costs of production. He cites especially the Toyoda automatic loom, which requires only one operative to 20 looms while an average British operative looks after only six looms. He shows that Japan's 8,000,000 spindles now produce almost as much cotton fabrics for export as England's 50,000,000 spindles, a disparity partly attributable to the idleness of many English spindles, but also to be explained by the fact that Japan's mills are better organized and managed.

Unified Buying

The advantageous position occupied by Japanese industry generally is well illustrated in the benefits resulting in the textile industry from the centralized method followed in importing raw cotton and exporting manufactured yarns and fabrics, assuring the purchase of raw materials at the lowest prices and the highest prices for manufactured cottons. While there are in Japan only four or five firms which buy raw cotton for all the mills of the country, and likewise act as the selling agents, the British mills depend upon innumerable small importers.

Of significant interest to the United States is Mr. Kawakami's comment that " Japan may well congratulate herself upon the fact that none of her major industries come into conflict with any of the similar industries in the United States. To a large extent, her trade has been supplementary to, rather than competitive with, American trade."

This is very largely true but it remains a fact that Japanese goods are now actually competing with sufficient American-made products—such as electric light globes, crockery and toys—as to include this country among those to whom Japan's trade expansion has become a vitally serious problem.

Indian Treaty Aids U.S.

Already Great Britain has taken steps to stop the storming of empire markets by Japanese goods, with the prospect that rigidly restrictive quotas will be applied to all such imports into the crown colonies and protectorates. In the early days of this year a trade treaty was consummated between Japan and India under which fewer Japanese goods will be allowed to enter that British protectorate and Japan will buy far less raw cotton from India than she formerly has. The cotton growers of the United States will be direct beneficiaries of this treaty.

The British position is stated as follows by Walter Runciman, President of the British Board of Trade : " Although the British government holds the view that the problem is one which can only be settled satisfactorily by co-operation in some form between Japan and ourselves, the British government cannot allow a possible situation to develop in which negotiations may be protracted indefinitely without any immediate prospect of settlement."

The reaction of the Japanese to the determination of Great Britain to seek a solution of the situation through recourse to a quota system affecting all of its territory is expressed in the statement of Eiji Amau, spokesman for Tokyo's Foreign Office, that " a decade ago the mere announcement of such a step would have upset Japanese industrialists. To-day they have more confidence in their power to meet competition."

Japan undoubtedly has more to lose than to gain in a relentless trade war entered into with a definite purpose of attaining dominance in the great marts of the world. Not only would such a movement inevitably bring about concerted action by the governments of the other great exporting nations, but it would spread bitterness against Japan among the workers in industries in other countries that have had either to close their doors or else reduce wage scales to meet the prices of goods manufactured in the Far East.

Fortunately such a lamentable eventuality is scarcely within the possibilities. Japan's leaders have made many apparently inexcusable blunders during her march to world leadership, but there is every reason to believe they are too astute to permit the development of such a situation, fraught as it would be with the undoing of much that their country has accomplished during the last half-century.

Electricity in Manchuokuo

" The Manchuria Electric Light Industry company and its subsidiary companies are supplying approximately 50 per cent of the electric power in Manchuria," General Toyohiko Yoshida, president of the company, said at the first general meeting of shareholders.

" A review of the present conditions of electric industries in Manchuria shows that out of the total generating capacity of 292,000 kilowatt-hours of electricity in this country, our corporation supplies 139,700 kwh. and the subsidiary companies 5,300 kwh, or approximately 50 per cent of the electric power in this country," he explained.

" Although it seems from this data that there are numerous electric enterprises outside the jurisdiction of our company, the fact is that they are mostly domestic power plants operated by special industrial firms situated in particular districts such as those of the Fushun colliery, the Penchihu Iron works, and the Showa Iron and Steel works in Anshan.

" As a considerable number of enterprises are being readjusted, I believe that the complete control of the electric industries will be realized in the near future.

" The company at present supplies electricity for 1,538,161 lights and 109,863 kwh. for electric power and 6,570 kwh. for electric heating facilities.

" As its new expansion program for this year, the company is planning to construct an additional power plant and a substation in Harbin, and new power stations in Hsinking and Tsitsihar."

The Aims of Japan

By BARON REIJIRO WAKATSUKI, Former Japanese Premier in "Foreign Affairs"

It is with considerable diffidence that I venture to present briefly my views concerning Japan and her aims, for I am not at all certain that I can say anything which has not already been said many times. I do, however, welcome an opportunity of addressing American leaders in the world of thought and diplomacy. I should like to talk to them, as it were, in an informal, heart-to-heart fashion. That will serve best, I believe, the cause of Japanese-American friendship.

I am firmly convinced, as a large number of Japanese are convinced, that friendship between the United States and Japan is essential not only to both countries but to the welfare of the entire world. Perhaps I may be permitted to be somewhat personal. Toward the end of 1929, on my way to the naval conference which was then about to open in London, I spent a few days in Washington, where I had the opportunity of conferring with President Hoover and Secretary Stimson. What was then uppermost in my mind was how to advance Japan's friendly relations with the United States.

To that end I considered it to be of the greatest importance that the two countries should come to an understanding on naval questions in advance of the London Conference. It was for that reason that I went to London by way of the United States. I recall with much pleasure and keen appreciation the hearty welcome given to me in Washington, and the friendly spirit in which both the President and the Secretary of State expressed themselves on various questions. Since then, whether as head of the Japanese government, or as the leader of a political party, or merely as a private citizen, I have always done all I could to promote Japanese-American friendship. Naturally I have followed with constant and careful attention American public opinion toward Japan, as well as Japanese public opinion toward the United States.

Japan's Situation

The results of the London Treaty and more recently the Manchurian incident shocked public opinion considerably in Japan and in the United States. There was a number of Americans who criticized and condemned Japan's policy, just as there were a number of Japanese who held similar opinions about the policy of the United States. But I believe that before a nation passes any judgment upon another nation's conduct, she should first consider what she herself would have done had she been in that nation's place. Therefore, I should like to ask you first of all to visualize clearly the situation confronting Japan.

I can readily enough see how difficult it must be for you to put yourselves in our place, as there are few points in common between the situation which confronts America and that which confronts Japan. The physical and geographical circumstances of the two countries are totally different, to say nothing of their histories or their customs and manners. Your country is compact, though vast in area ; it is peopled rather sparsely, though the total population is great ; and it is immeasurably rich in natural resources.

In fact, America is almost entirely self-sufficient and self-supporting. Ours is a country consisting of many small scattered islands, extremely overcrowded, and so poor in natural resources that we must largely depend on imports for our supply of raw materials. The neighbors with whom you may have troubles are either small or militarily quite impotent. On the contrary, we are face to face with two great continental powers—China, with an area 16 times as large as ours and a population of 400,000,000, and the Soviet Union, with an area 30 times as large as ours and a population of 160,000,000. Moreover, these two countries, by reason of the exceptional conditions prevailing in them, have been sources of constant anxiety to Japan.

In view of such an absolute difference in the situations of Japan and the United States, it may be too much to ask that you put yourselves in our place before you criticize our actions. But this you should try to do, just as we should try to put ourselves in your place before criticizing your actions. And I cannot help believing that, if you were in our place, you would be doing exactly what we are doing to-day.

Nippon Home Issues

As regards the domestic situation of Japan, we are faced first of all with a most pressing problem of population. We have at present a population of 90,000,000 and, because of the smallness of our area, Japan is one of the most densely populated countries in the world. This population, I must also point out, is increasing very rapidly, at the rate of eight or nine hundred thousand per annum.

Although it is only a few decades since we came into close contact with the Occident, Japan is an old country. We have long been known as an active and energetic nation. Marco Polo, who returned to Venice in 1295 from his travels on the Asiatic mainland, wrote of the "indomitable courage of the people of Zipangu." More than 300 years after Marco Polo's time our country entered upon a hermit life, which lasted from 1636 to 1858. During that period the isolationist policy of the Tokugawa Shogunate suppressed the expansive vigor of the people. But as soon as the Meiji Restoration lifted the ban on foreign intercourse, the long pent up energy of our race was released, and with a fresh outlook and enthusiasm the nation has made swift progress.

When you know this historical background and understand this overflowing vitality of our race, you will see the impossibility of compelling us to stay still within the confines of our little island home. We are destined to grow and expand overseas. Well, then, whither ? If Japan had, like America or Great Britain, immense and sparsely populated territories, it would not be necessary for us to go to Manchuria or anywhere else on the Asiatic mainland.

The United States, Canada, Australia, and New Zealand and other regions in the Pacific, with vast areas and scanty populations, where there is much room for emigration, are closed to us for no other reason than that we are Japanese. As for the question of Japanese immigration into the United States, while we resent strongly the discriminatory treatment to which Japanese are subjected, it is after all a question for the solution of which we consider it best to appeal to your sense of justice.

Very recently, when an anti-Japanese movement arose in Arizona, we relied for the settlement of the affair entirely upon the sense of justice and fair play of Americans. We do not wish to send our immigrants to any country where they are not desired. While we believe that the American law for the restriction of immigration is decidedly unfair to us, we are not disposed to demand the entry of Japanese into the United States against the wishes of the American people.

The path of our expansion lies, then, naturally in the direction of Manchuria, which is contiguous to Chosen. It was because of our concern for the peace of East Asia no less than because of our conviction that our only path of progress lay on the continent of Asia that at the time of the Manchurian incident our nation rose spontaneously as one man to grapple with the situation. The Manchurian affair was really a life-or-death struggle for Japan.

Japan's Industries

Let us turn to Japan's industry. It is a fact that of late our industries have developed notably and that our country is being fast industrialized. In this connection, I should like to call your attention to two points—first, that the industrialization of our country will contribute to the solution of our population problem ; and secondly, that our industrial and commercial expansion has brought in its wake many serious international problems.

Westerners are in the habit of gauging the culture or civilization of a nation by its standard of living, and of vaunting their generous desire to bring the other peoples of the world up to their level of enlightenment.

That is in a way true. Now we Japanese are doing our best to elevate our standard of living, which is not quite so high as that of some Occidental peoples. And it is to that end that we are developing our industry and commerce, which is practically the only way to increase our national wealth since our country is so poor in natural resources. We reorganized and improved our commercial and industrial methods. We worked patiently and tirelessly until we were in a position to compete in the world market with other advanced nations.

However, we at once encountered a stupendous obstacle in the form of a boycott in China, the biggest market for our merchandise. When on February 24, 1933, the Assembly of the League of Nations adopted a report which declared that the Chinese boycott subsequent to the Manchurian incident was a legitimate means of reprisal in the light of international law, China was virtually closed to Japanese trade.

There are those who accuse Japan of attempting to close China to other powers, but as a matter of fact it was Japan who was shut out of China. We were forced to seek the outlet for our merchandise elsewhere. The flow of Japanese goods into various quarters of the globe was, though largely due to quality and price, traceable in part to the anti-Japanese agitation in China.

Trade Barriers Elsewhere

Great Britain and other powers then began to adopt the quota system and other measures for preventing the importation of Japanese goods into their territories, despite Japan's protest that such action was a violation of commercial treaties. In view of the fact that Japanese articles, because of their good quality and cheapness, are welcomed by a large majority of the consumers in every country, and are in especial demand amongst the native populace of the European colonies in Asia and Africa, one cannot but conclude that the home governments are sacrificing the interests of large numbers of consumers in order to protect a few producers.

It is questionable, however, whether a country can ultimately succeed in an attempt to protect its industries by artificial devices for the exclusion of foreign goods, without endeavoring either to improve its industrial organization and technique or to increase the efficiency of its workers. Accordingly, I doubt very much if the prevailing economic nationalism, inaugurated by the European powers, can continue indefinitely.

At any rate, it is a regrettable fact that they are erecting various trade barriers to obstruct the free interchange of goods, and thus handicapping the cause of human happiness and progress. I believe that freedom of trade is essential for the promotion of the mutual interests and well-being of the nations. I hope, therefore, that all the powers, casting aside short-sighted policies, will put international trade back upon the normal basis where it ministers to the wants of each and where it furthers mutual prosperity.

What Trade Expansion Means

However, to return to my first point, the promotion of Japan's foreign trade is closely knit up with her international relations inasmuch as it directly implies the expansion of her industries. This in its turn advances Japan's culture and civilization by raising the standard of living, and offers an effective means of solving her population problem.

The world is moving forward constantly. But we cannot shut our eyes to the fact that the backward nations are moving at a much faster rate, in order to catch up with the more advanced nations in culture and civilization. Thus the Asiatic nations, now wide awake, are struggling to approach the level of European and American nations. It is necessary, then, in the interests of world peace and harmony, that the advancing nations be given adequate spheres of activity and expansion. Japan, which is forging ahead at a very rapid pace, is surely one of those nations.

Japan's Neighbors

Let us now examine Japan's environment.

Our relations with China date far back in history. Even during the period of isolation under the Tokugawa regime, we continued to have friendly intercourse with China. But when early in the last decade of the 19th century she adopted an aggressive policy toward Chosen, and threatened the peace of the Far East, we fought her (1894-95) and drove out Chinese influence from the peninsula. Following the Sino-Japanese War, China concluded a secret treaty with Russia, by which the latter was given the right to construct the Chinese Eastern Railway in Manchuria in return for a promise to come to China's aid in case of another war with Japan. Once entrenched in Manchuria, Russia launched out upon the conquest of the Far East. We fought her in 1904-5, and drove out Russian influence from South Manchuria.

In 1912, the Manchou dynasty fell, and China became a republic. It was Sun Yat-sen himself, father of the Chinese revolution and founder of the Kuomintang party, who preached the doctrine of so-called "Great Asianism," urging the co-operation of Japan and China and declaring that China should abandon Manchuria as being the most likely source of Sino-Japanese friction.

And it was the Canton government, set up by Sun Yat-sen, which sent the expeditionary force under Chiang Kai-shek to the north and succeeded in establishing the present Nanking regime. But after the death of Sun Yat-sen, the leaders of the Kuomintang, and later the authorities of the Nanking government, adopted the ruthless anti-foreign policy called, "revolutionary diplomacy." They attempted to check the powers by playing off one against another. Hoisting the banners of "anti-imperialism" and "abrogation of unequal treaties," they clamored for the abolition of extraterritoriality, the return of foreign concessions at various ports, the cancellation of the Boxer Indemnities, etc.

At Washington Conference

Now earlier, at the Washington conference, we had made concessions to China which few other great powers similarly situated would have made. We had done this out of our growing sympathy with China and in the hope that after achieving unity and setting her house in order at an early date, she would redeem the various obligations which she had undertaken at that conference. It was such sanguine hopes and liberal beliefs which caused us to sign the Washington treaties regarding both the navy and China.

These hopes were dashed by subsequent events. China failed to meet her obligations under the Washington Treaty. Indeed, our conciliatory attitude only served to increase her arrogance. In particular, our position in Manchuria became more and more precarious. There accumulated between Japan and China more than 300 unsolved questions. It was in this tense atmosphere that the Manchurian incident occurred in 1931.

The split between China and Japan caused by the Manchurian incident lasted for some time. But of late the leaders of both the Chinese government and the Kuomintang, realizing the folly of persisting in their antagonism toward Japan, and understanding better her real intentions, have been assuming a friendly attitude in harmony with the spirit of Sun Yat-sen's teachings.

As a result, it seems to me, Sino-Japanese relations are now on the way to being restored to a normal basis. At the time of the Manchurian incident, there were many critics in other countries, especially in yours, who severely censured our action. But now that Sino-Japanese relations are taking such a favorable turn, European and American fears seem to have been groundless.

However, China has still to reckon with the communists who have their strongholds in Szechuen and Kueichow. These are establishing contacts with their comrades in Sinking, across the province of Chinghai which is practically a no-man's land. And there is the southwestern party which maintains an independent regime in Canton, and refuses to take orders from the Nanking government. Such a state of disunity is directly or indirectly a source of concern to us.

Our Neighbor Russia

The Soviet Union is another neighbor of ours. The aggressive policy of the Czarist government brought on the Russo-Japanese War, as the result of which Russia was forced to withdraw from South Manchuria. The government of the Soviet Union was reported to have made a declaration in 1919 to the effect that it would abandon all the old Russian concessions in China; but it retained its rights in the Chinese Eastern Railway and held North Manchuria securely as its sphere of influence until the establishment of Manchuokuo in 1931.

Since then, Moscow seems to have found it necessary to retire. However, in Outer Mongolia and in Sinkiang, the Soviet Union has consolidated its position. Although by the Sino-Soviet treaty of

1924 the Soviet Union recognized Outer Mongolia as an integral part of the Republic of China, Moscow had previously (in 1921) signed a separate treaty with "The People's Government of Mongolia," recognizing it to be "the sole lawful government of Mongolia," and the two governments later exchanged plenipotentiary representatives.

To-day Outer Mongolia is virtually a Russian protectorate administered under a Soviet system. The present head of Sinkiang province, Sheng Shih-tsai by name, is dependent on Russian support and the province is completely under Moscow's domination.

The aim of the Soviet Union is to bring about a world revolution and set up a proletarian dictatorship everywhere. The Soviet leaders have persistently worked to achieve their objective, though with varying intensity. For some years the communist movement in China was widespread, and until very recently held Kiangsi and several other provinces in its grip. When the Union of Socialist Republics of China was established, with its seat of government at Suichin, the pamphleteers in Russia urged an alliance of the two Soviet unions of Russia and China. And they raged furiously over the advent of Manchuokuo because it shattered a convenient link for that projected alliance.

How They Affect Japan

The policies and internal situations of China and Soviet Russia being what they are, these two great and close neighbors of Japan affect us both directly and indirectly. We once had to fight China, and then we had to fight Russia, at a great sacrifice of blood and treasure, for the preservation of the peace of East Asia. The peace of East Asia would not have been maintained, nor would the rights and interests of the powers there have been secured, if Japan had not played the part of a watchdog. On the peace of East Asia hangs the fate of our nation.

Other powers may have important interests there, but these interests at most concern only their commercial prosperity, whereas the interests which we have are vital. I doubt if you have anywhere outside your borders interests so vital to you as those which we have in East Asia are to us. But supposing we did interfere in some question involving your vital interests, how would you feel about us ? Our concern over affairs in East Asia is surely far more profound than any you ever have felt over questions touching your neighboring states. That is why we cherish so earnestly, and are ready to guard at any price, the peace of East Asia.

Naval Problems

I feel I cannot leave the naval question out of any general discussion of Japan's problems.

The preliminary naval conversations opened in June of last year were adjourned in December, and the results are now being carefully considered by the respective governments concerned, with a view, no doubt, to paving the way to a formal conference in the near future. Those conversations served a useful purpose in that they clarified the viewpoints of the three major naval powers as to their respective requirements, policies and intentions.

Viewed in that light, the London parley was not a failure but a success for naval accord is possible only when each of the interested powers knows where and how the others stand. Since the findings at London are now being weighed by the three governments it would be inappropriate for me to go too far in detail into the subject at this time.

I was present as Japan's chief delegate at the London naval conference of 1930. The difficulties which that conference had to face at the outset were many, including not a few that seemed well-nigh insurmountable. I need not touch here upon the difficulties experienced by the delegates of the other powers, but shall confine myself to our own problems.

MOST IMPORTANT QUESTION

To Japan, the most important question was whether or not the naval ratio of 5-5-3, which as you all know had been adopted at the Washington conference of 1922 for the American, British and Japanese capital ships and aircraft carriers, respectively, should be extended to cruisers, destroyers and submarines.

Japan took the stand that the same ratio should not be applied to auxiliary craft, and we submitted an alternative plan. Other powers failed to agree to this plan on certain important points. It became obvious that our insistence upon our own formula would wreck the conference. We thought the consequences of a failure would be most unfortunate to all, and therefore, taking a larger view of things, we accepted, though reluctantly, a basis of deliberation that would lead the conference to success instead of failure.

When I signed the resultant agreement on April 22, 1930, I issued a written statement, in my official capacity as Japan's chief delegate, in which I made it clear that the agreement was not to serve as a precedent in any subsequent naval conference. I stated plainly my hope and expectation that at the next conference, which was to meet within five years, the powers would reconsider the whole question of ratio on a new basis. In spite of the unequivocal reservation which we made, it was, I must confess, an ungrateful task for us to sign the London naval treaty. We did sign it in the hope that it might materially contribute toward international harmony and particularly toward our friendly relations with the United States.

DISSATISFIED WITH RESULTS

However, as the years passed the popular dissatisfaction in Japan with the London conference and the London naval treaty grew in intensity, and manifested itself in one way or another upon various occasions.

To-day there still remain a number of pending naval issues between Japan, Great Britain and the United States. As has been officially stated more than once, our proposition is that each power should maintain such a navy as will not menace other powers—a navy insufficient for attack but adequate for defense—and that the armament should be reduced to the very minimum required for defensive purposes so as to lighten the tax burden of the peoples concerned.

A fundamental point in the naval problem, and one which I think Americans should bear in mind above all others, is that neither Japan nor any other power on earth can effectively attack or invade their vast continent. Occasionally I read press dispatches from Washington reporting military and naval appropriations amounting to hundreds of millions of dollars.

Of course that is an internal question for your country with which no foreigner should interfere. But you should keep in mind one thing, namely, that you are in a position in which no nation can attack you either from the Pacific or from the Atlantic, either from the air or from the sea. No naval power can ever blockade you. The mere size of your territory and population, the magnitude of your wealth and resources, stand as an effective warning against any possible contemplation of foreign aggression.

In this respect Japan is the very opposite of America. From the standpoints of geographical position, topography, and size of territory and resources, as well as because of other circumstances, our country is not secure from external menace. We keep our navy for the sole purpose of defending our land. We harbor no aggressive designs against others, nor do we even contemplate sending our fleets near the waters of another country. We do not believe that a foreign power should possess a navy capable of menacing another country.

Japan's Peace Work

Following the World War, the nations, eager to secure a permanent peace and to dispense with the old world order which was based on the balance of power and under which one alliance was pitted against another, brought into being the League of Nations. The war-weary nations of Europe and all the other peoples rejoiced in the hope and belief that peace—a permanent and universal peace—had dawned upon the ruin left by the war.

At the Washington conference, held shortly thereafter, we made all possible concessions and signed the treaties concerning China, expecting that that country would forthwith set to work to restore order and achieve unity. We also signed the naval treaty which was to prevent a needless naval competition among the sea powers. And subsequently for some years our government pursued a policy of drastic retrenchment not only on naval but also on military expenditure.

HOPES BEGIN TO FADE

But the glowing hopes we had entertained for the new world order began to fade. In Europe the frail structure of international relations founded upon the various peace treaties quickly broke down. The entire continent has long been plunged into a precarious state of instability and unrest. In the Far East, China not only failed to redeem the obligations and commitments she had made at the Washington conference but embarked upon a campaign for the recovery of certain rights and interests and for the expulsion of foreign influence from within her borders.

The Soviet Union had consolidated her position in East Asia, especially in Outer Mongolia, and at the same time expanded her military strength. Meanwhile, ever since the conclusion of the London naval treaty, which complicated and beclouded the naval situation, Japan had been seized with a growing feeling of uneasiness and discontent. Finally, there occurred the Manchurian incident, followed by the establishment of Manchuokuo.

Bright Side of Situation

If we look on the brighter side, we see that very recently there have been signs that things are taking a turn for the better in our part of the world. Manchuokuo has made rapid and healthy progress in all directions. Sino-Japanese relations are fast being restored to normal. The amicable settlement of the North Manchuria Railway question has served to relieve the tension between Japan and the Soviet Union, so that we may hope for a whole-hearted tripartite co-operation and collaboration in the Manchurian region between Japan, Manchuokuo and the Soviet Union. We are doing our best to promote these new hopeful tendencies in East Asia.

Finally, let us consider Japanese-American relations. From the very beginning of our intercourse some 80 years ago when Commodore Perry first arrived in Japan, our two countries have remained on the friendliest terms. These became most warm and enthusiastic during the years of the Russo-Japanese War.

But as Japan began to grow in power and prestige, somehow the United States began to show signs of apprehension. There arose between the two countries vexatious questions—the California question, the Chinese question, the Manchuria question, the naval question—which from time to time caused considerable irritation on both sides. To-day there are still many questions pending. But they are all such as can be solved through diplomatic means. Certainly there are no pending issues that might possibly jeopardize our essentially friendly relations.

U.S. Will Understand

I believe that Americans will soon come to comprehend correctly the Manchurian question and to appreciate fully Japan's position in East Asia. When you know exactly our position and our aspirations in East Asia, you will readily understand our attitude and claims concerning the Chinese and the naval questions. I am confident that the sense of justice and fair play of Americans will in the end solve satisfactorily the immigration question.

In the field of trade, I do not anticipate that we shall encounter any troublesome questions with your country such as we have with some other countries. Even if there should arise any difficulties, we surely should be able to adjust them amicably. If each of our two countries understands the other's position and aims and endeavors to promote peace and harmony by taking always a broad view, all the questions between us will be easily settled, and our friendship will grow more cordial than ever.

Japan is faced with many problems. Our path of progress is strewn with difficulties. But all we ask of the other nations is that they acquire a correct comprehension of our position and aims in East Asia. We do not care to meddle with the affairs of Europe or America.

We are concentrating our efforts upon the stabilization of the situation in East Asia, as a nation with vital interests there. We have no intention to menace or attack our neighbor states, but on the contrary are endeavoring to carry out with them all a pacific policy based upon the principle of live and let live. Such are the obligations, as they are the aims, of Japan in East Asia.

Japanese Naval Policy

By HUGH BYAS, in the "Japan Advertiser"

JAPAN and the United States are spending colossal sums on ships of war which have never fired a shot in anger and in all probability never will. The figures for the United States, Great Britain and Japan, as given in the latests authoritative work, Sea Power in the Modern World, by Admiral Sir Herbert Richmond, professor of naval history at Cambridge, published September, 1934, are as follows in millions of dollars:

	U.S.A.	*Great Britain*	*Japan*
1934	287.5	277.5	207.5
1912	130	220	47.5

In the period covered by those figures a great war has conferred on the world a peace of exhaustion. Yet America's naval expenditure has risen by 120 per cent and Japan's (starting from a lower level) by more than 300 per cent. If armaments are a form of insurance, it would seem that unstinted expenditure has not provided the security sought.

Against what risks are they seeking to insure themselves? What are the dangers which call for this enormous expenditure?

National Security

Compared with European countries, both of these lands enjoy a high degree of natural security. Japan is separated from the mainland of Asia by a wider and more stormy channel than that which saves England from invasion. Instead of powerful armed and industrial nations, Japan, when her eyes cross the Japan Sea, confronts China and Russia. These are difficult and uneasy neighbors but they are quite unable to invade or blockade Japan. On the other side of the Pacific lies the United States. She is Japan's neighbor in a sense, but is separated from Japan by the largest ocean mass in the world. Invasion of Japan from either the Asiatic or the American side is impossible in face of her strong and efficient army, able to put a million trained men in the field on mobilization; and naval blockade, in Japan's geographical situation, would require a supremacy at sea which even the world's strongest fleet does not at present command.

Those conditions are known. They explain the difficulty which foreign observers feel when they try to understand Japanese dissatisfaction with the Washington Treaty. If Japanese naval officers could accept that treaty twelve years ago, why cannot they accept it to-day?

An answer has been offered by the highest authority, Admiral Mineo Osumi, Minister of the Navy, who recently declared: "Whereas twelve years ago the Washington Treaty might have been adequate to guarantee Japan's security, the subsequent changes in international relations have been such as to make those terms wholly inadequate to-day." The statement does not help us much. Japan certainly is no longer an active member of the League of Nations, but the Admiral can hardly mean that up till last year Japan relied on the League for protection against the United States. Isolation at Geneva may have been unpleasant, but it brought no tangible hardships in its train, and some unpopularity abroad (such as the United States experienced during the Spanish-American War and Great Britain during the South African War) is a small price to pay for carrying through a great policy of national aggrandizement. If the changes in international relations alleged by the Admiral are the only reason why the Washington ratios have become inadequate, one can but ask what new complications the navy foresees. Japan's strategical situation *vis-à-vis* the United States is unchanged. She is as safe from blockade or invasion as before—as safe as America herself.

The Japanese might be better advised not to take refuge in political generalities when they are asked questions to which Americans sincerely desire a straight answer; but if there is to be any agreement—and there ought to be—it is necessary to get a clear understanding of what the Japanese are worried about. Where their fears are unreasonable, let the unreason be pointed out.

First of all, what is the Japanese navy for? Its defensive purposes can be quite clearly defined. It must be strong to cope with any hostile fleet which might be sent to Japan and to keep open Japan's communications with her sources of food and vital supplies on the mainland of Asia. About one fourth of Japan's foreign trade comes over the short sea routes in the China and Yellow seas. Her imports of coal, iron ore, rice and beans follow these tracks, and the trade routes with Europe, Africa, Australia and Asia converge into this area. The principal long-distance trade routes used by Japan are those across the Pacific to North America and round by Singapore and Suez to Europe. These are, in a sense, alternative routes, and neither is by itself absolutely vital. The short sea routes are vital, and there is no alternative source readily available for the supplies thus derived.

Japan's Existence at Stake

Those functions are accurately described as defensive since they are absolutely necessary to Japan's national existence. Her determination to possess a fleet strong enough to defend her from blockade and invasion by the navy of any foreign power is clearly legitimate. Before going further it will be useful if we clear away a somewhat common fallacy. Japan's naval policy can also be stated in terms which, though equally accurate, convey more than a suspicion of aggressive intent. Japan, it is said, wants a fleet strong enough to prevent America or any other power from interfering with whatever she may choose to do in China. That suggestion has a sinister sound. It ignores all the actual and formidable restraints on Japan's supposed ambitions in China—the influence of European powers with great interests there, the passive resistance of four hundred million Chinese, the historical fact that China has absorbed all her conquerors, the consequences on Japanese trade of any adventure which increases Chinese hatred of Japan. But there is nothing in the suggestion because, in reality, there is no difference between these definitions. A fleet strong enough to defeat an attack on Japan is strong enough to prevent forcible intervention in Eastern Asia by any western power.

Behind the technical details of naval controversy, there is consequently a question of principle and national policy. What are fleets for? Does American policy require a navy strong enough to fight and defeat Japan in defense of American interests in the Far East—such an American interest, for example, as the principle of commercial equality in China, embodied in the famous Open Door doctrine of John Hay? It is necessary to put this question to clear up a common misunderstanding. It is supposed on one hand, that Japan seeks a navy of a certain strength in order that she may have a free hand in China; and, on the other, that, though America does not want to attack Japan she needs a fleet strong enough to restrain Japan from certain actions in China. But that is a double fallacy. An American fleet strong enough to restrain Japan in China would also be strong enough to invade Japanese waters. Mr. Hughes's legal acumen pierced to the heart of the fallacy at Washington in 1922.

The principle which guided the Washington Conference was equality of security. Japan asked for defensive parity, and accepted a ratio of 60 per cent because her delegates recognized that remoteness is an element of security. When the difficulties and risks of bringing a fleet across several thousand miles of sea were considered, Japan's 60 per cent fleet was assumed to be as good as America's 100 per cent fleet would be after it had crossed the Pacific. The Washington Conference in effect divided the Pacific into spheres of influence; and, by leaving Japan supreme in her home waters, Mr. Hughes gave a negative answer to the question whether the United States fleet should be strong enough to defend American interests in China.

The Washington Conference

The findings of the Washington Conference were embodied in the celebrated formula 5-5-3. As not infrequently happens in human affairs, the formula has tended to acquire the importance of a principle itself. But there is nothing sacred or eternal in the figure 5-5-3; they merely represent in tabloid form the proportions which, as applied by the Conference to the British, American and Japanese fleets, provided, in the view of the three governments at that time, equality of security. The Conference did not start from a formula, though many of the arguments now being heard start from the formula. The formula represented the end and the result of its labors. Conceivably it might have been another combination of figures. All it had to be was something which at that time embodied the principle on which naval limitation was possible. To have started from a formula in which one of the parties was assigned a lower ratio than the other two would have been a stigma of sorts, as some Japanese patriots have represented 5-5-3 to be. But the 5-5-3 ratio has nothing to do with rank or precedence or merit. It is merely an arithmetical formula embodying a decision which, at the time, was satisfactory to all three parties.

What we are seeking is the Japanese answer to the question: Why, if 5-5-3 gave Japan defensive parity in 1922, should it fail to do so still? It is obviously a very serious thing to discard a formula which was arrived at only with difficulty and at the cost of sacrifices by the American fleet, and which seems to benefit Japan as much as and perhaps more than the United States. While Americans need not regard demands for a change in the formula as the sin against the Holy Ghost, Japanese need to remember that they can lose very seriously by ill-thought-out attempts to dispense with it.

The 5-5-3 formula succeeded in reconciling two naval policies which at first sight do not seem easily reconcible. The policy of Japan is to build a fleet " powerful enough to defend Japan against any force which could be dispatched to the Western Pacific by any naval Power of the World." That of America, announced in 1920 and still maintained, is " the creation of a navy equal to the most powerful maintained by any nation in the world." This is the famous doctrine of parity with the strongest, as enunciated and accepted at Washington in 1921. It absolves the United States from the responsibility of leading in any naval race. But it ties American naval policy to British; the size of the American fleet is regulated by the size of the British. This involves for Japan a problem different from that created by a large British fleet. The British fleet's principal bases are in European waters, and the principal function of the British fleet is to protect the food routes of the British Isles against attack by European powers. Japan can afford to neglect the British fleet, strategically speaking. But when there comes into existence an American fleet equal to the British, with bases in the Pacific, linked to the eastern seaboard by the Panama Canal, the Japanese formula " powerful enough to defend the country against any force which could be dispatched to the Western Pacific " becomes more difficult. Having accepted the lower ratio, Japan has accepted the greater risk, and it need not be held against her that she is nervous.

Both the Washington and London agreements are " political "; they were accepted by a Japanese government of economizers and liberals desirous of maintaining the friendship of England and the United States, and influenced by the postwar ideas of international peace embodied in the League of Nations. Those settlements were accepted by the navy only under protest and, as it were, on trial. The liberal elements are no longer in power; they have been temporarily overwhelmed in Japan and elsewhere by a wave of nationalism. The League of Nations has been abandoned. Japan found herself isolated in the Manchurian controversy, and conceives that she must henceforth stand alone. She is now guided by the " general staff " mind—the mind which considers military strength the only basis of national security.

Parity with Britain

Parity with the British Empire, as the Japanese see it, is not really an American necessity, the circumstances of the two countries being so diverse. Why then did they accept that fateful element of the settlement? They remembered that, though American administrations had often framed naval programs, Congress had regularly failed to appropriate the necessary funds. They explained this habit of Congress by supposing that American security was not really at stake and that the American people would still sleep soundly in their beds without a great fleet. They may have thought that, since the right to parity had been recognized, it would be not exercised. The Hoover administration showed no great haste to exercise it.

The Washington agreement had left the ten-thousand-ton cruiser as its legacy, and, as vessels of this type were gradually added to the American fleet, the dislike of the Japanese Navy for the Washington settlement increased. It was intensified by the fact that the engineer can always beat the statesman. The "Washington" cruiser has become a new type, capable of steaming long distances from its base, and able to shoot not merely twelve or fifteen miles from its guns but one hundred or one hundred and fifty miles, or even more, from the airplanes that it carries. This extension of range carries an increase of risk to Japan. Her industrial life is concentrated in a group of wooden-built cities of her eastern seaboard which are specially vulnerable to attacks from the air. Her submission in substance is that the character of fleets has changed since the Washington agreement was made and that a ratio of 60 per cent no longer provides a fleet able to "defend Japan against any naval force which could be dispatched to the Western Pacific by any naval Powers of the World."

Since it is open to Japan to make full use of engineering progress and raise her 60 per cent fleet to the same level of power as it possessed before Washington, this argument might be difficult to sustain logically. But the increase of cost in building a fleet corresponding to that of the United States is a fatal obstacle. The fleet so provided would, moreover, be costly to run and needlessly elaborate for Japan's purposes. She therefore proposes a scaling down all round in size and cost, and the replacement of the 5-5-3 formula by something more flexible. She wants a stronger fleet at less cost; and she wants also a fleet which will prevent the United States from interfering by naval force in the affairs of Eastern Asia. There have been hints in Foreign Office utterances that some political step towards the recognition of Japan's preponderant rôle in the Far East (the so-called "Japanese Monroe Doctrine") would enable the naval demands to be modified. Since Washington does not seem prepared to make such a gesture, Japan must build the navy needed to sustain a position of complete political isolation.

Abolishing Aircraft Carriers

The scaling-down in size, the abolition of aircraft carriers and other changes Japan proposes in her pursuit of a stronger yet cheaper navy would hamstring the American fleet and give the United States a navy which experts consider unsuited for her purposes. The differences between the Japanese and American viewpoints are therefore clear-cut and fundamental because they arise from different needs. The Japanese have thought out their course, and we must expect that they will pursue it. Claiming that a pocket edition of the American fleet is both expensive and useless to them, they have denounced the treaty and are prepared to run the risk that the United States will embark on a huge program. They have pinned their faith to "defensive" arms, which for them, as against the American fleet, means submarines; and vast numbers of those invisible craft, lurking among the islands of the Pacific, will be the answer to American programs.

It is difficult to foresee the ultimate effects of the abandonment of the promising beginning made at Washington in the regulation of fleets by mutual agreement. The Japanese contend that it need not be so tragic as the friends of peace fear. That treaty, they say, created artificial standards. It has given both Japan and the United States bigger and more expensive fleets than they foresaw. After it is terminated, both will in course of time return to the pre-war custom of building the fleets they need for security; and, since Japan has no intention of menacing America or of interfering with affairs outside of Eastern Asia, America will have no motive for building on a large scale.

How far those expectations will be justified, remains to be seen. Disappointment over the failure which at present seems inevitable should not blind us to certain considerations of a hopeful nature.

First: The Japanese demands may be unacceptable to the United States, but that will be due to different needs and circumstances. They do not appear to violate the principle of the Washington settlement, which provided equality of security by dividing the northern Pacific into Japanese and American spheres.

Second: The explanations usually offered for rivalry in armaments do not apply to Japan and the United States, or do not apply adequately. America covets nothing Japan possesses, and does not stand in the way of the economic expansion which Japan needs. Japan, on the other hand, can attain that economic expansion without clashing with any vital interest of America or infringing the Open Door doctrine. No question exists, or seems likely to arise, between the two countries, which contains any serious risk of war.

Third: Their naval programs, whatever they may have become, did not originate in their own relations. Japan's first large building scheme was planned at the time when her statesmen expected that czarist Russia would prepare a war of revenge. The American decision to create a fleet second to none was due to the determination that a European war should not again expose American trade to the humiliations of 1914-1916. It was the inherent peacefulness of Japanese-American relations which enabled Secretary of State Hughes to make the first naval conference a success. The conditions have not changed in essentials; there is still no rational cause for a Japanese-American conflict; and the principle of equality of security which Mr. Hughes applied has not lost its power.

ROAD-BUILDING IN KIANGSI

Among all the provinces where the work of road-building is being vigorously pushed forward, Kiangsi has shown the most remarkable progress. Although construction of roads in Kiangsi was started with the establishment of the Provincial Highway Bureau in 1925, yet progress has never been so rapid as in 1934, in which year more than double the mileage of roads completed in previous years was built. It is largely to this fact that the recent success was due of the military operations against communist-banditry in Kiangsi.

Prior to 1934 a total of 2,238 kilometers of highways was completed, of which 1,170 kilometers were main roads, 362 branch roads, and 706 district highways, but during 1934 there were built 524 kilometers of trunk roads, 256 kilometers of branch roads, and 1,537 kilometers of district highways, making a grand total of 2,317 kilometers. Paved roads amounted before 1934 to 1,198 kilometers—trunk roads, 662 kilometers; branch roads, 362 kilometers; and district highways, 174 kilometers, while in 1934 a total distance of 1,622 kilometers was paved, of which trunk roads represent 666 kilometers, branches 169 kilometers, and district highways 787 kilometers. In all, Kiangsi has now 4,555 kilometers of highways, of which 2,820 are already paved.

In regard to traffic, satisfactory progress is also seen. There were before 1934 about 1,480 kilometers of roads already opened to traffic, with 262 motor-buses in operation, but during that year 1,090 kilometers of new roads were opened to traffic, while the number of vehicles running increased to 427. Bus-stations, formerly numbered 94, but during last year 53 new ones were built, making a total of 147. Business receipts from this means of transport amounted to about $1,267,000 in 1933, but increased to $2,916,500 in 1934, more than double the previous year's total. It is particularly satisfactory to note that the motor-bus business showed a very remarkable increase during 1934 in spite of the bandit-suppression operations that year, and now that these military activities have been concluded, the increased volume of bus traffic will be more marked than ever.

In addition to the 4,555 kilometers of roads completed in 1934, there are another 1,055 kilometers on which work has been started, but is not yet finished. The next effort by the Highway Bureau will aim at the completion of these unfinished roads and at the improvement of road conditions so that safety of traffic may be assured and the economic development of the province more easily attained.

China's New Factory Enterprises

Mr. Louis Beale, the British Commercial Counsellor at Shanghai, is in England for the purpose of discussing with manufacturers and merchants interested in the export of United Kingdom goods to China the present and future prospects of trade in that country.

China continues to display remarkable recuperative power in defiance of adverse circumstances. In spite of depression brought about by various and widespread causes, and in the face of higher tariffs, some of which might well be regarded as prohibitive of import, and many of which have resulted in extensive smuggling, the total customs revenue during the first 10 months of 1934 was very little below that of the corresponding period of 1933.

Not many years have passed since it was said of China that the adoption by its teeming millions of some article of Western civilization would result in a vast accession of activity to European factories. Goods with which this prophecy was linked included cigarettes, rubber-soled shoes, safety razors and electric torches. But great changes have taken place in the Far East since those optimistic views were expressed. Not only have the manufactures of Japan increased greatly in volume and variety and obtained a strong and extensive foothold in China, but factory development in China itself has proceeded apace. As a result the foreign trade of the country has gradually been transformed.

What happened in the cigarette business is to some extent symptomatic. The success of the importing interests in years gone by was followed by local manufacture, which grew rapidly—bringing with it a large import of cigarette-making machines. An export trade was built up which reached its zenith in 1928, when cigarettes to the value of over £3,000,000 were sold abroad. In the ensuing year, however, owing to taxation, labor troubles, and competition from foreign-controlled concerns, many of the Chinese cigarette factories were compelled to close their doors, and exports fell in value by about 40 per cent. Home consumption and distribution also were adversely affected by internal disorders.

Early Successes

There is not space here to give details of the numerous branches of manufacture which have been introduced in China. Among early successes, apart from the many well-known textile manufacturers, may be mentioned tinned meats and fruits, pickles, sauces, etc., biscuits, soap, scent, imitation jewelry, suitcases, shoes, spectacles, and toys. Noteworthy recent examples of advance include furnishing fabrics, curtains, electric fans with locally manufactured fractional horse-power motors, metal filament lamps, circuit breakers and transformers.

The attitude of the Nanking Government to the question of importations versus the establishment of manufacturing industries within the country is indicated in the announcement of the approved proposals that have been referred to various departments for examination. They include the erection of an automobile factory with the object of " checking economic leakage due to the importation of foreign cars," and the adoption of a protective policy for the promotion of home industries. An equally interesting and more practical proposal that has been approved in to utilize military labor for water conservancy.

The movement to establish factories will undoubtedly grow, under the initiative of Sino-foreign concerns as well as purely Chinese enterprise, and the consequent changes in import trade are likely to be so rapid and extensive as to demand the keenest attention of those interested. Some time ago Chinese firms undertook the construction, to European and American designs, of so-called standard types of machine tools, and also of cigarette-making and similar machines. Although in quality these are far below the imported machines they serve their purpose, more particularly as they are relatively cheap. But under the pressure of competition in the sale of the finished goods, manufacturers in China will be forced to purchase and install the more effective type of equipment and consequently there are reasonable prospects of increase in the sale of imported machine tools and factory equipment of many kinds.

Prospects Against Japan

It will be interesting to see to what extent the new Chinese entrants into the field of industry will be able to compete with their Japanese rivals. Their labor is even cheaper, but much of their machinery and practice is not equal to the Japanese. Further, in China a large amount of imported semi-finished material has to bear duty. But there is no doubt that in exporting to territory where their countrymen have settled the Chinese have a great advantage.

With the support of the Chinese Government and the banks an association of Chinese manufacturing exporters recently dispatched a mission for the purpose of extending their trade in southern and south-eastern Asia. Encouraged by the success attained in Malaya special attention has been given to markets where the Chinese are numerous and prosperous. Among the samples carried were fabrics of silk, cotton, rayon and mixtures, hosiery, knitted goods, umbrellas, mats, toilet articles, small hardware, electrical appliances, optical ware and preserves.

In the case of a large number of manufactures, exporters are handicapped in their efforts to extend their sales abroad because their costs are unduly increased not only by the import duties charged on the semi-finished material but also by the export levy on goods which have not been entered by the Customs on its " privileged " list. It proves very difficult, if not impossible, to comply with all the complicated regulations connected with obtaining inclusion in this list.

An exporter, writing in the *North-China Herald*, gives instances of goods made in Shanghai which he finds too dear to sell in neighboring countries in competition with either the Japanese or European article. He says that in Manila a British-made electric fan can be sold more cheaply than the Shanghai-made article, and German nails more cheaply than Shanghai nails ; in Singapore and Manila Chinese enamelled goods are undercut by both German and Swiss manufactures ; Hongkong flashlights are at least 50 per cent cheaper than Shanghai flashlights.—*London Times Trade Supplement.*

SINGAPORE SEWERAGE SYSTEM

Having unanimously agreed that Singapore should possess an up-to-date sewerage system the Municipal Commissioners have decided to spend $8,000,000 on the provision of such a system. If Government approves, the $8,000,000 will be raised by loan ; half of it at once. There are four schemes drawn up by the staff and consulted upon by an expert from home, Mr. J. D. Watson. All the schemes provide for the elimination of crude night soil from the Alexandra Road works, the main trouble in the past. The scheme recommended by the consultant represents a complete departure from the present method of sewerage purification. Water-brone sewerage would be treated roughly as at present, but in respect of the crude night soil, instead of mixing it with the water-borne sewerage, the solids later taken out and retreated, it would be pumped direct to the dry purification beds. The tritus which remained in the Alexandra Road works would be pumped out, mixed with the night soil and would help to digest it on the site of the new works, wherever they might be. With regard to the effluent, the recommendation of the committee is that bio-flocculation units should be interposed between the tanks and the final outflow into Serangoon River. The effluent would then be odorless, and contain only about five parts of suspended matter in 100,000.

The Boiler Plant Installed in the Nanking-Hsiakwan Electricity Works

By Dipl.-Ing. A. KIEWNICK, Berlin

THE power station of the Capital Electricity Works of Nanking, which has been in operation since 1932, occupies a commanding and conspicuous position on the banks of the Yangtze River. The station affords convincing evidence of the unshakable confidence with which China—notwithstanding the worldwide depression and the political unrest—regards the future of her economic life. It is one of the most up-to-date power stations in the country and is a credit to the German engineering firms that built and equipped it.

Fig. 1 show a general view of the power station. Its erection took place under the general direction of Messrs. Siemens-Schukert-Werke, of Berlin, the well-known German engineering works. The outward appearance of the building conforms to the type now largely used, i.e., it rises—as it were—in steps. The outer rooms are relatively low, but the central portion of the whole premises, the bunkering plant of the boiler house, is very considerably higher, and dominates all the rest. The whole boiler plant has been supplied and erected by Messrs. A. Borsig A.G., of Berlin—a firm which has acquired an excellent reputation abroad because of the numerous orders it has executed for foreign clients. Messrs. Borsig have also, conjointly with Messrs. Siemens-Werke, supplied the largest boilers on the Continent of Europe (in the power station of Berlin-West), each of them having a heating surface of 2,400 sq. meters, whilst normally generating 120 tons of steam per hour. The following lines are intended to give a brief description of the Borsig boilers supplied to the Nanking Electricity Works.

The new power station contains two units, each having a heating surface of 720 sq. meters. The boilers are of the grouped-tube

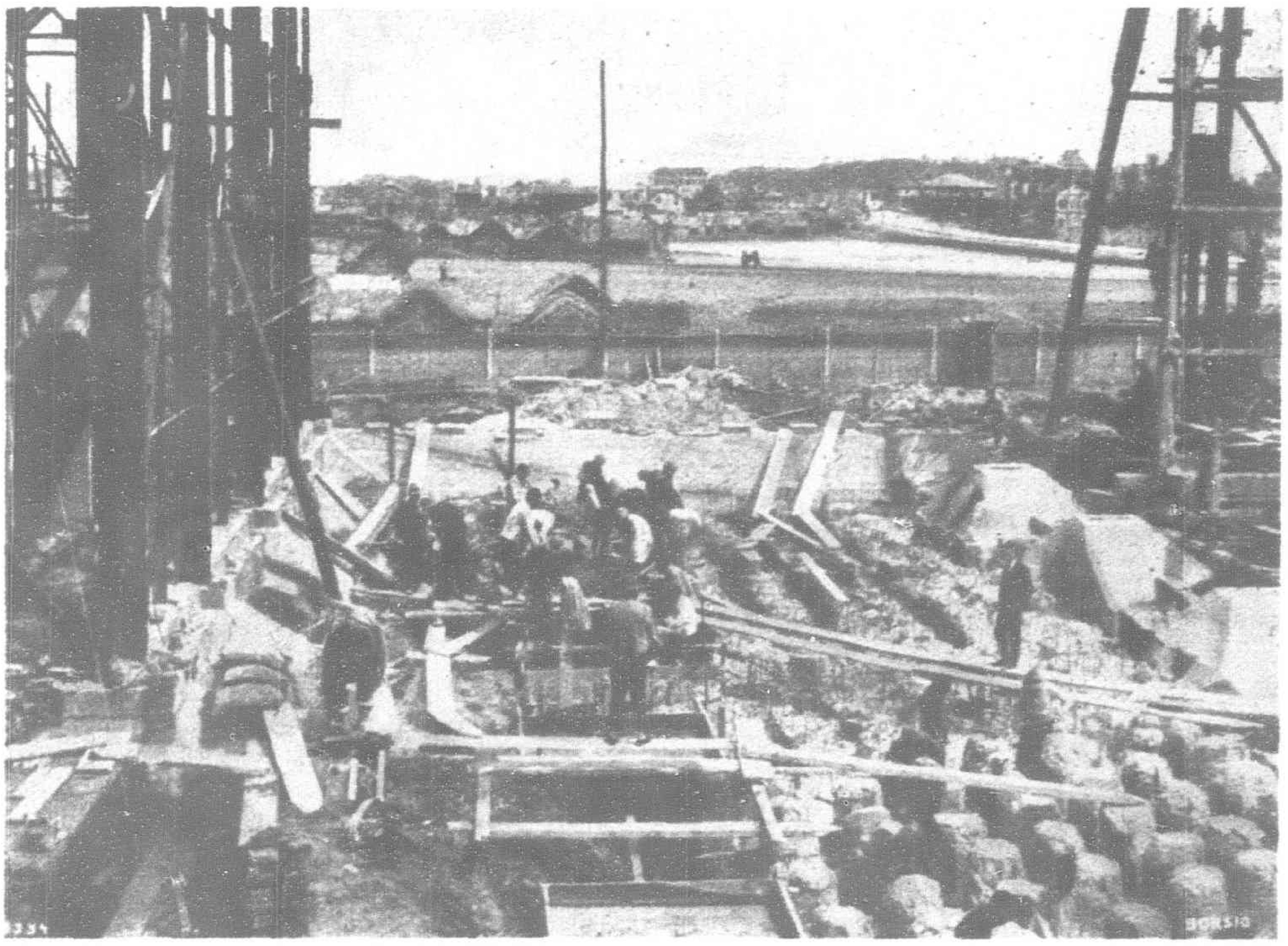


Fig. 2.—Foundation of boiler plant

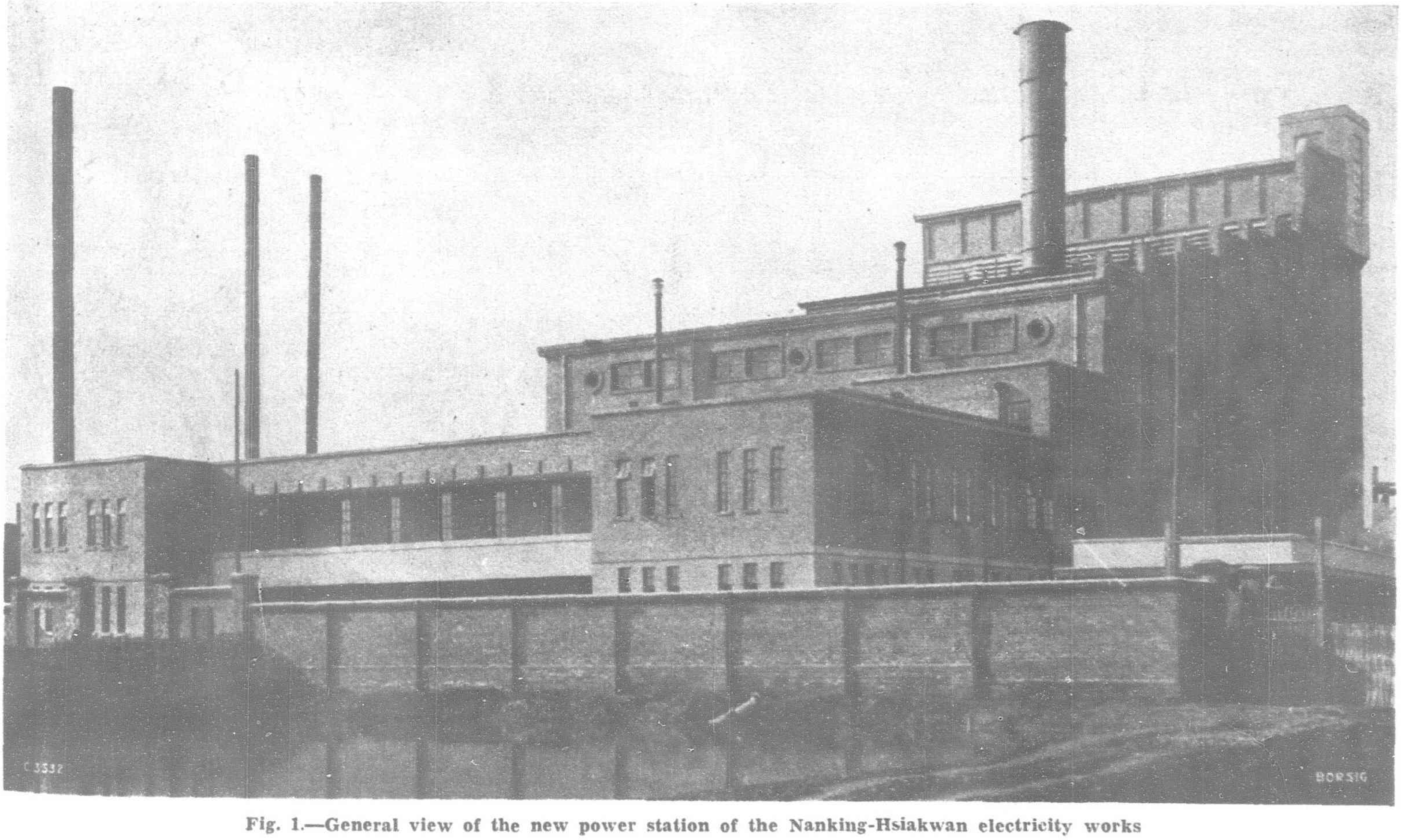


Fig. 1.—General view of the new power station of the Nanking-Hsiakwan electricity works

type. They are provided with superheaters and a joint feedwater pre-heating plant of 1,350 sq. meters and generate steam subject to a pressure of 32 atm. (above atmospheric). The furnaces are fitted with Borsig forced draught travelling grates.

The erection of the power station commenced in 1931. The heavy type of boilers resulted in very considerable pressure on the ground, so that particular attention had to be paid to the laying of the foundations. As the soil consists of alluvial deposits of the Yangtze River, the actual building work had to be preceded by careful tests of the subsoil. Fig. 2 gives a rough idea of the difficult work thus involved, and also shows the type of reinforced-concrete construction used. As soon as the foundations had been laid, the necessary scaffoldings were erected and the drums and sections were hoisted (Fig. 3). Although the workmen available for this part of the work were entirely unskilled, the erection was completed within a few months' time.

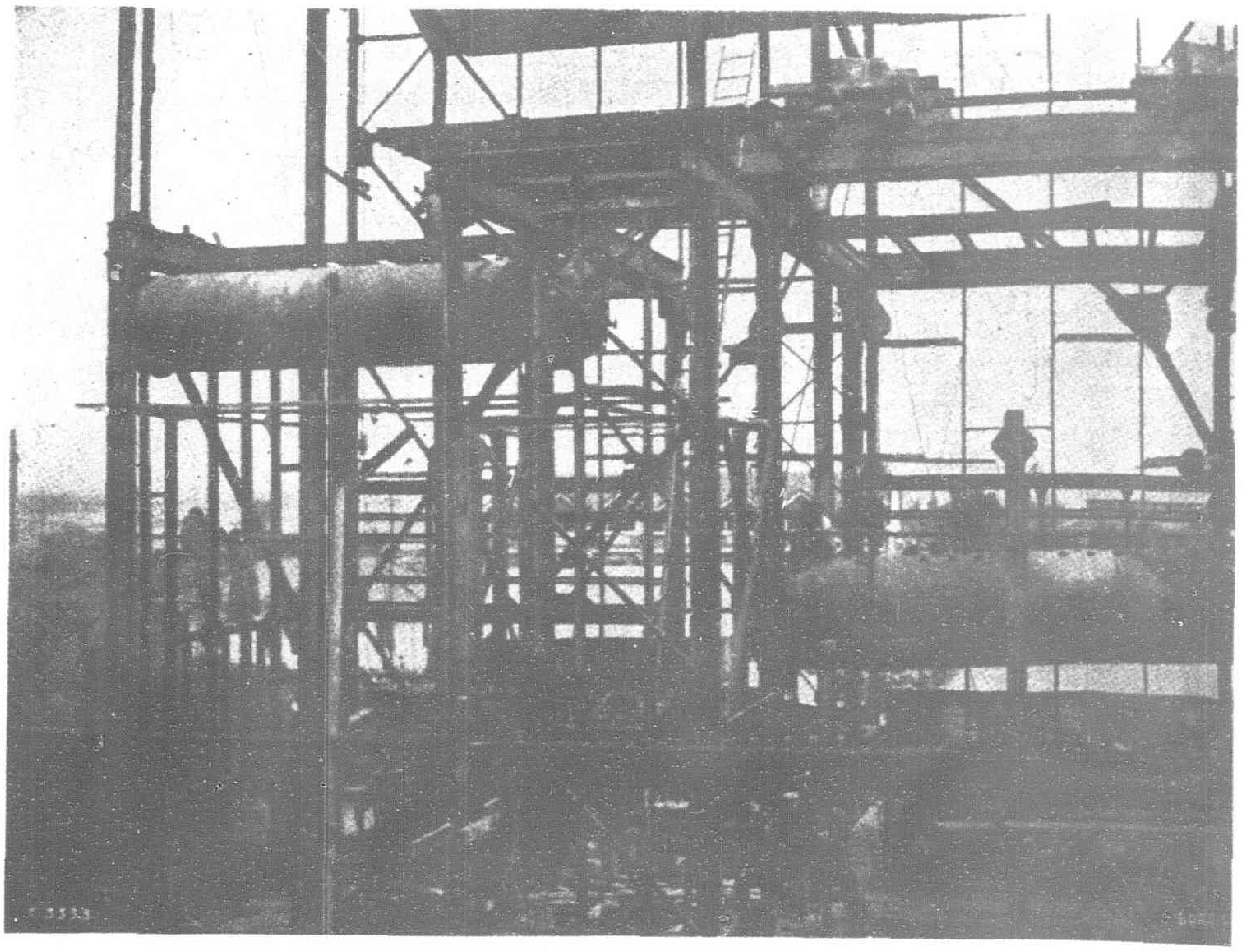


Fig. 3.—Hoisting the boiler drums during erection

Fig. 4 shows a longitudinal section across the boilers. It also gives a good idea of the design used for transverse boilers, which makes allowance for the expansion due to heat. Owing to the special method of suspending the drum, the headers and the superheaters, all these parts easily respond to all stresses that may occur in operation. Above all, the rolled-material surfaces are not subjected to additional strains. These remain absolutely tight and the inconvenience of working them up every now and then is eliminated. In order to ensure that the water level in the drum is as undisturbed and as uniform as possible, the tubes establishing connection with the front sectional headers have been made to start from a point situated above the normal water level in the drum. Thus, the formation of air bubbles in the water contents and that of inadmissible steam-space stresses is out of the question. Special mention should be made of the strong walls with which the sectional headers are fitted. The water circulates through the headers without any eddies, because—as may be seen from Figs. 5 and 6—the plugs fitted to the walls of the sectional headers are flush with the inside wall and cannot give rise to current resistances. Another interesting feature is that the corners of the headers are very rounded (Fig. 7). It is a well-known fact that sharp corners and edges may often cause cracks and other damage to the materials employed.

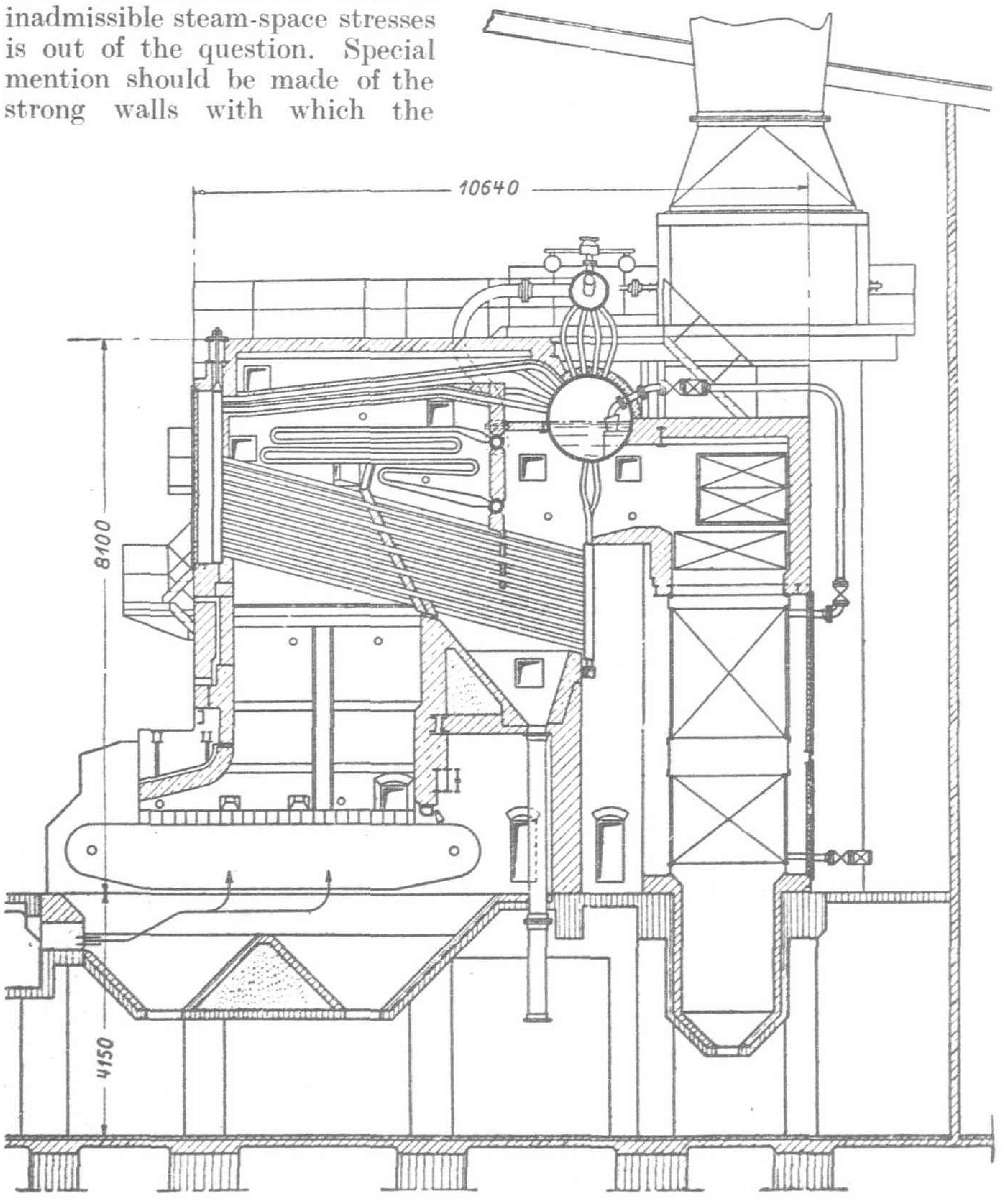


Fig. 4.—Longitudinal section of boiler

Particular attention was devoted to the making of the sections, which took place in Messrs. Borsig's own workshops (Fig. 8) and after their patents. After passing through the drawing shop, they were carefully annealed and then—as customary—subjected to a water-pressure test (Fig. 9) at twice the normal working pressure, i.e., 65 atm. (above atmospheric). Next, they were provided with the boreholes for the tubes and with the stop-up holes and were tested as to their satisfactory condition and to the prescribed thickness of the walls. The enormous capacity of Borsig headers in regard to high pressures was demonstrated by a test in which the pressure was raised to 300 atm. without causing any lasting deformation.

The greatest care is applied to the selection of the materials. The headers are made of a special kind of steel possessing a strength of 44 kgs. to the sq. milimeter when subjected to an elongation of 22 per cent and capable of resisting the highest temperatures that may occur during operation. For reasons connected with the beading of the tube ends, the tubes must possess a lesser degree of strength. They are made of steel and their strength equals 36 per cent for 26 per cent elongation. The kind of steel used for their making ensures that the beading places receive the most careful treatment.

The kind of coal used for fuel contains about 40 per cent of gaseous ingredients, so that—with a view to remunerative working —the greatest importance had to be attached to the design of the gas sides of both boilers, i.e., to the shape of the furnaces and to the details of the flue construction. Considering the kind of fuel to be used, the provision of a high combustion chamber alone could not hold out a guarantee for complete combustion. It is true that the flues must be rather long in high furnaces, but the currents are subdivided, and the eddying of the heating gases is very small for temperatures ranging between 1,200 and 1,400 degrees centigrade and for velocities of about three meters per second. The furnaces were therefore designed in such a manner that an overgrate blast can be admitted to those parts of the combustion

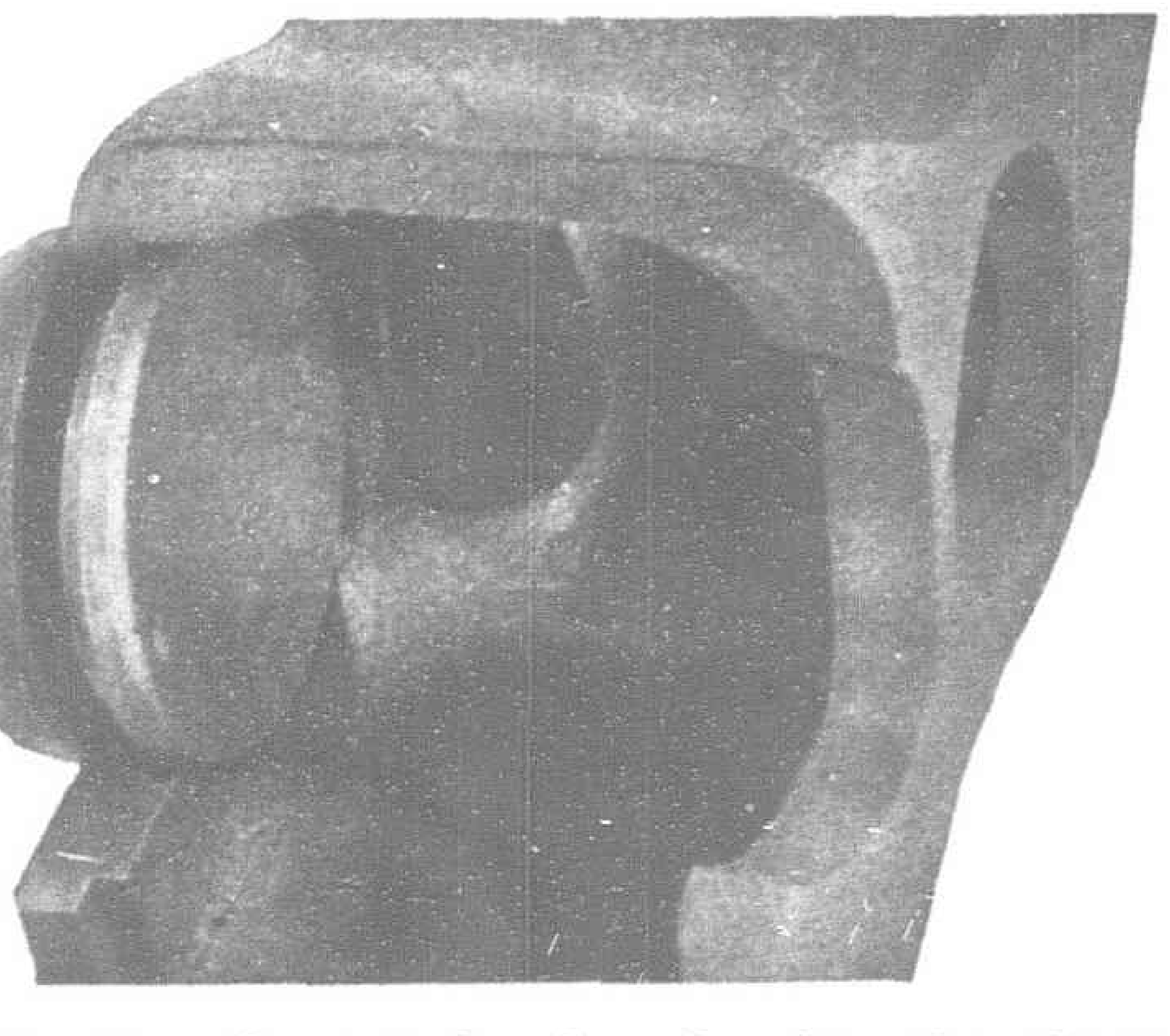


Fig. 5.—Section through header showing the plugs flush with the wall

chambers in which it is particularly desirable that the gases should burn completely. The same purpose is served by the Borsig eddying air admissions, which make it possible to obtain a favorable CO_2 percentage without giving rise to the formation of any CO, especially when the load is high. Where this system is used, combustion has already come to an end before the heating surface is reached; and subsequent combustion in the nest of tubes with its resulting inconveniences cannot occur. In order to ensure a maximum of remunerativeness in connection with the transmission of heat and the draught requirements, the velocity of the gas in the boiler flues was fixed at from three to five meters per second.

The velocity of the steam in the superheater is about 12 meters a second, so that the tubes are adequately cooled. As to the data for the superheater, it was important to bear in mind that the boiler plant only works from 7 to 11 p.m., i.e., for four hours, with a normal load, whilst during the remainder of the twenty-four hours not more than 35 per cent of the normal load is required. For this reason the superheater surface was very liberally dimensioned. Failing this, the low average performance would have involved very low steam temperatures, and this might have given rise to the danger of the last few blade rims of the turbine becoming corrugated owing to the excessive steam moisture. In order to prevent that, during the periods of peak performance, the steam is raised to too high a temperature, the boilers have been fitted with injection cooling devices.

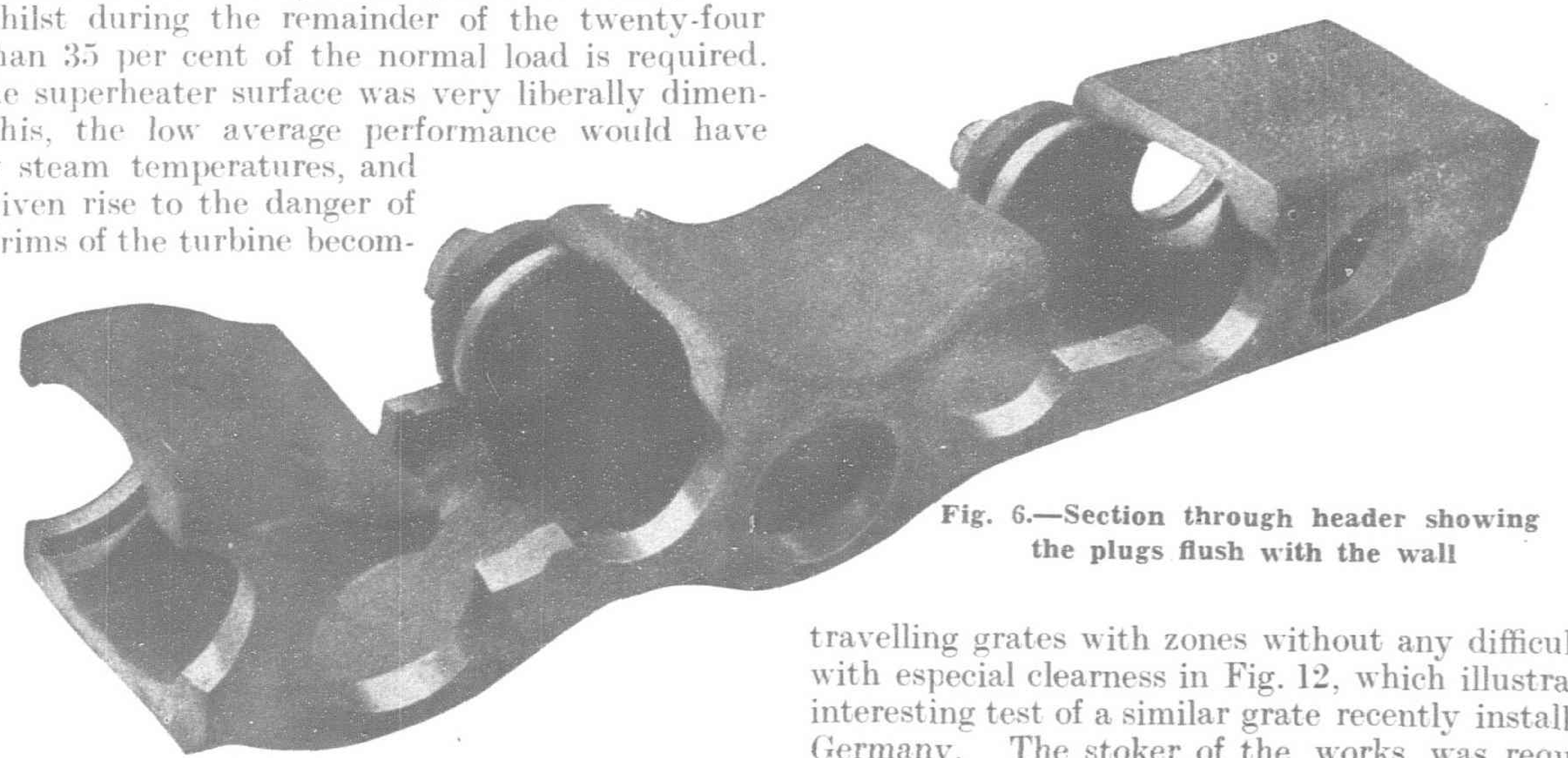


Fig. 6.—Section through header showing the plugs flush with the wall

Each boiler has a Borsig forced draught travelling grate with zones 5.4 meters wide and of a total surface of 31 sq. meters. The grates are of the single type and belong to the widest of their category. Forced-draught operation was resolved upon, first, because the coal to be used is so gaseous that a considerable quantity of oxygen has to be admitted, and second, because of the fine granulation of the coal (from 0 to 20 millimeters, including 50 per cent below three millimeters), which forms a kind of layer on the grate offering a comparatively large resistance. The zone system was preferred because of the considerable fluctuations in the load required for the operation of the Electricity Works. By supplying the air for combustion in zones it becomes possible to distribute the forced draught over the whole length of the grate or any desired part of it, so that the excess of air is as small as possible no matter what the load may be. In addition, it ensures the constant presence of an adequate amount of CO_2. Its principal advantage, however, is that the furnace can be adjusted to any change in the amount of tapped steam within a few seconds. Thanks to this high degree of adjustability and to the safety of the operation of the furnace the boiler reserve can be put down at a minimum. It should be emphasized that owing to the heavy and carefully-designed forced draught installation all zones are adequately independent of one another, which is especially important for part-load operation. When the boiler output is low, the rear part of the grate is usually but slightly covered with coal. Any air, however, deviated from neighboring zones would not only materially reduce the efficiency of the furnace, but would also blow away the thin layer of coal which must always cover the grate in order to protect the bars against the heat irradiated from the furnace.

Grates of so large a size are subject to very considerable stresses, and only special materials can resist them. Hence, extensive tests of materials were made prior to taking in hand the actual work. Fig. 10 shows a testing mechanism intended to measure the influence of the temperature of the grate bars upon the temperature of the holders and the resulting deflexion at varying stresses.

In order to prevent the lateral walls from being washed out at the level of the layer of coal and the deposition of slags, the lower parts of the furnace walls have been fitted with cooling beams, which are likewise connected to the circulation of the water in the boilers. A movable fire bridge at the end of the grate prevents the admission of unsuitable air to the rear combustion chamber and ensures satisfactory combustion because of the accumulation of the slags. The fire bridge is likewise equipped with a cooling beam intended to absorb heat of radiation equal to from 1 to 3 per cent of the heat generated for useful purposes and connected to the feed water pipes. Owing to the slight caking capacity of the coal used, the removal of the ashes from the second and third flues is effected in such a manner that the flue coke deposits can be dealt with by a lock incorporated with the ash-removal pipe. If, however, the forced draught is adequately attended to and if the coal is well moistened, such flue coke deposits can be reduced to a minimum.

Fig. 11 shows, in diagrammatic fashion, the steam generated by a boiler during a normal working day. The peak performance during the evening is plainly indicated by the curve. Every evening the boiler furnace is required to adjust itself, in a minimum of time, to an increase in the load to more than three times the daily output. It has already been pointed out that such changes can be conformed to by the Borsig travelling grates with zones without any difficulty. This is shown with especial clearness in Fig. 12, which illustrates the result of an interesting test of a similar grate recently installed with a boiler in Germany. The stoker of the works was required to adjust his furnace to very high peak loads that would suddenly occur in conformity with a schedule unknown to him. Although he had only had very little training, he succeeded—as the diagram proves—in completely mastering his task without difficulty by simply actuating in a suitable way the feeding device and the forced-draught supply mechanism. It should be taken into consideration that the fuel used in the works concerned was of poorer quality still than that used at Nanking, viz., coke dust of a size varying between 0 and 8 mm., and that the conditions imposed were particularly difficult inasmuch as during the second half of the test a change-over had to be made, after a ten hours' interval, from no-load to the generation of 28 tons of steam per hour. The change could be effected within four minutes. Even though such peak loads will hardly ever occur in the Nanking Electricity Works, the great flexibility of the Borsig forced-draught furnace illustrated by the test gives the works superintendents an absolute assurance of being equal to any abnormal operating conditions in any way.

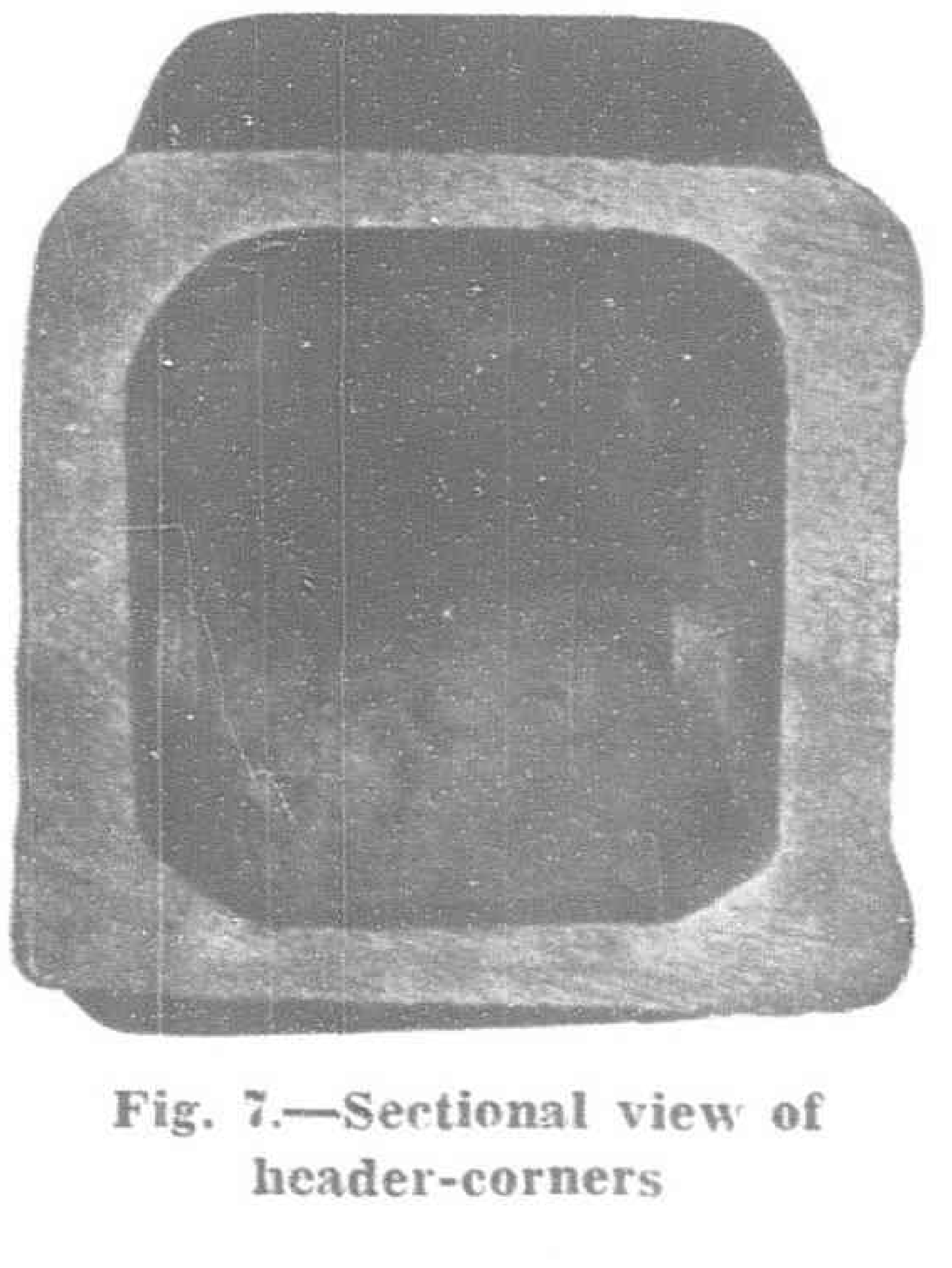


Fig. 7.—Sectional view of header-corners

With a view to checking the undertakings given by the makers, a number of tests were made in the summer of last year under the

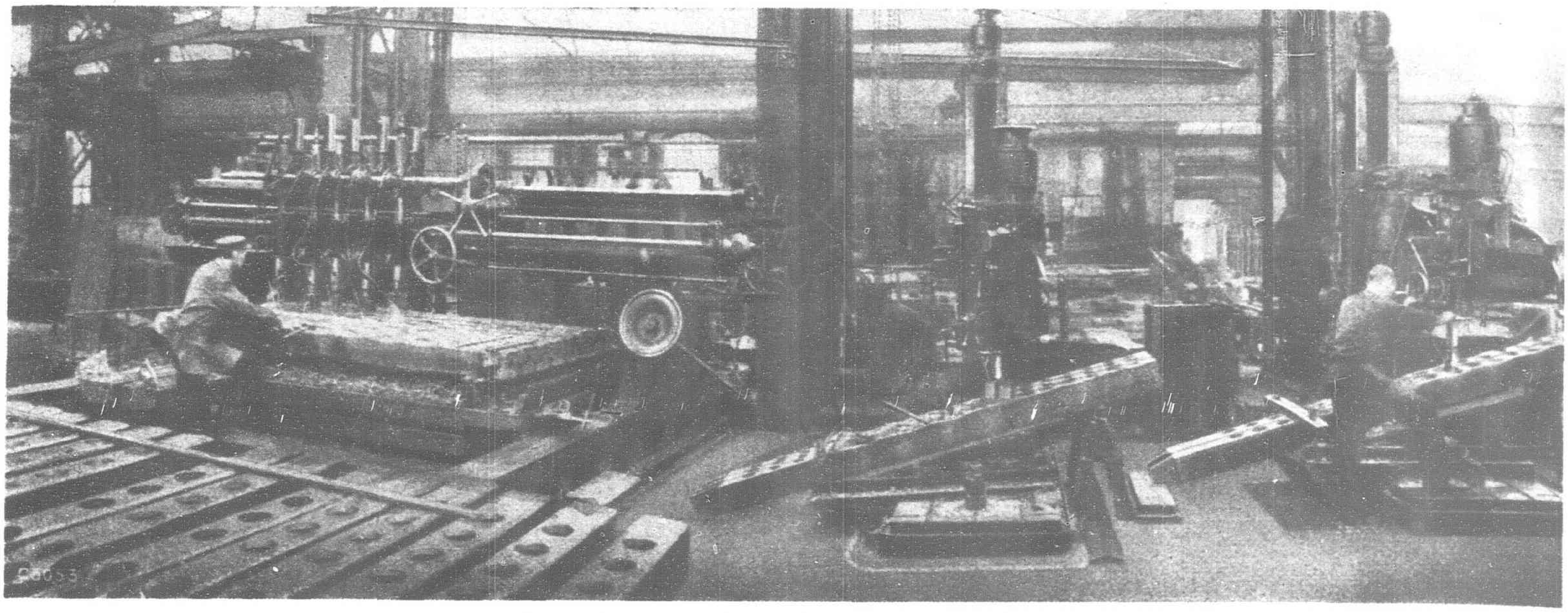


Fig. 8.—Manufacturing of headers in the workshop

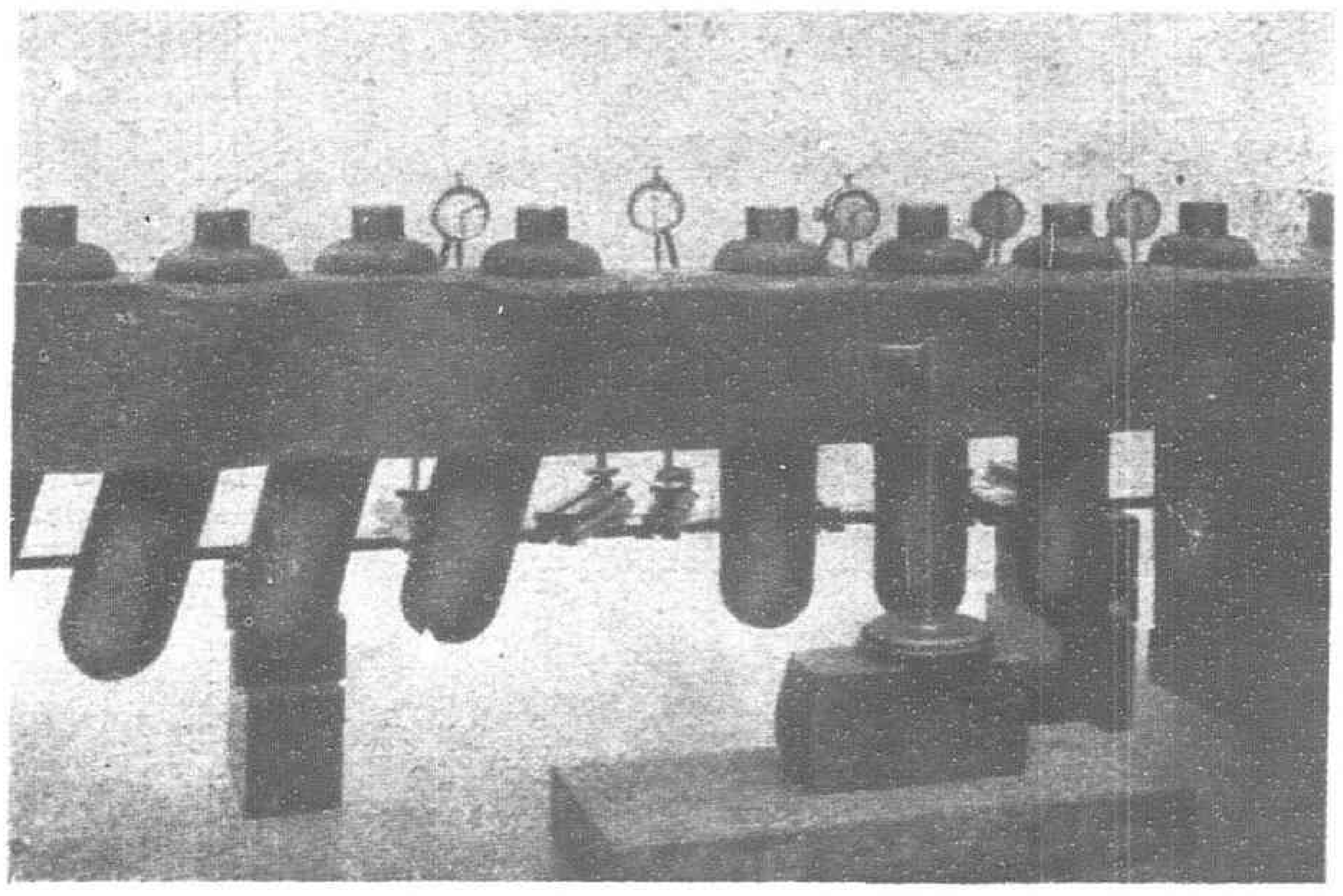


Fig. 9.—Water pressure test for headers

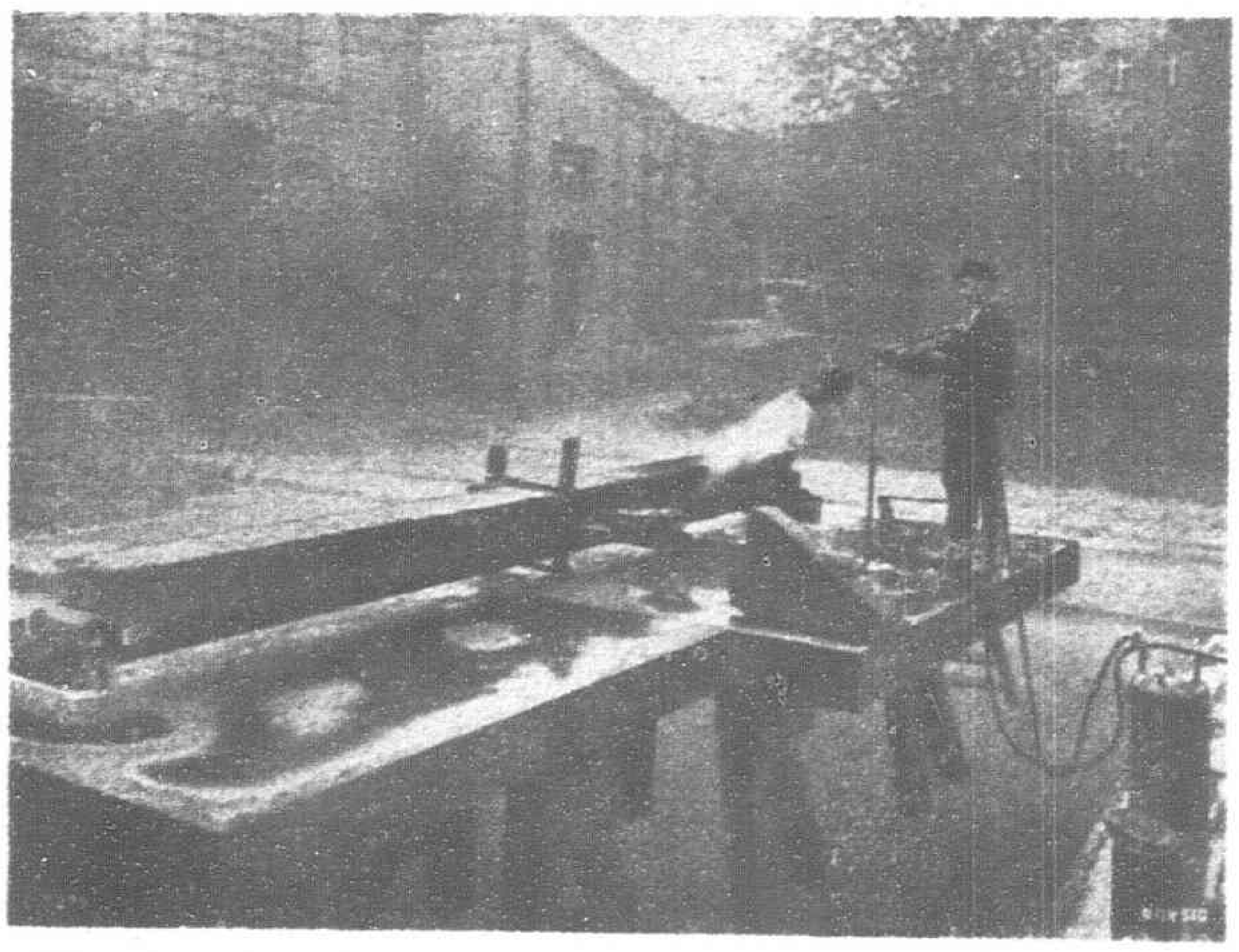


Fig. 10.—Devise for testing grate materials with high temperatures

direction of the Nanking Power Station. It had been guaranteed that, for a co-efficient of efficiency of 81 per cent, the normal quantity of steam generated would be 40 kgs. per sq. meter, of 32 atm. (above atmospheric) and of 385 degrees centigrade, and that, for a co-efficient of efficiency of 76 per cent, the maximum quantity of steam generated would be 50 kgs. per sq. meter, of 32 atm. (above atmospheric) and of 400 degrees centigrade, assuming a minimum heating value of the coal of 6,000 kcal per kg, a percentage of ashes not exceeding 24 per cent, a feed water admission temperature of 100 degrees centigrade, and a maximum intensity of draught of 50 mm. w.d.g. It must suffice to select two out of the large number of tests then made, one showing the behavior of the boiler plant for normal and the other for maximum loads.

Fuel :		*Normal Load*	*Maximum Load*
(1) Data :	kcal.		
(*a*) Minimum heating value	per kg.	5732	5784
(*b*) Water contents	%	8.9	7.6
(*c*) Contents of ashes	%	19.9	20.0
(2) Consumption :			
(*a*) Per hour	kgs.	4000	4800
(*b*) Per hour and per 1 sq. meter of grate surface	kgs.	131	157
Feed Water :			
(1) Temperature before Economizer	°C.	102	100

(Continued on page 269)

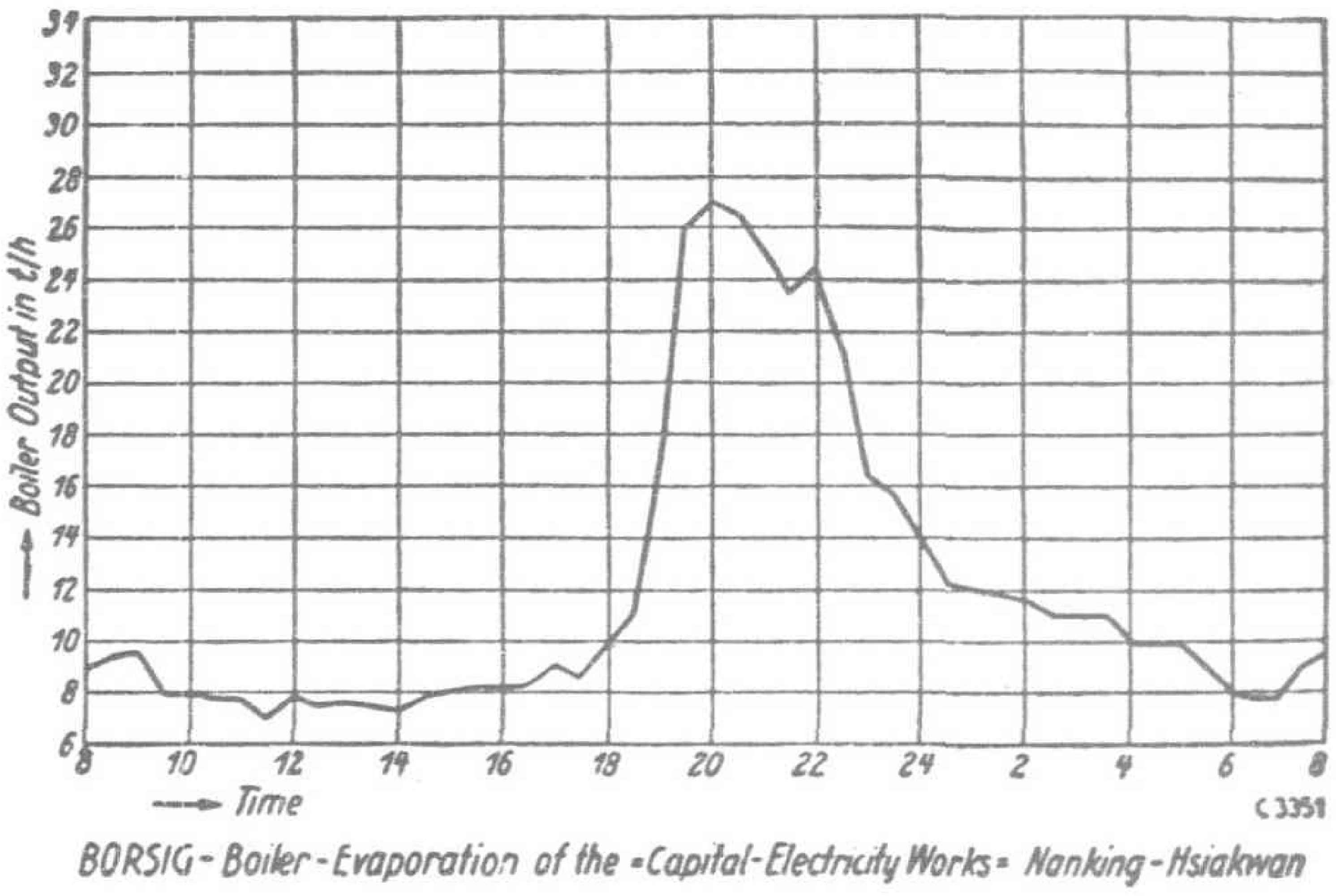


Fig. 11. Diagram showing steam generation of a boiler during a normal working day.

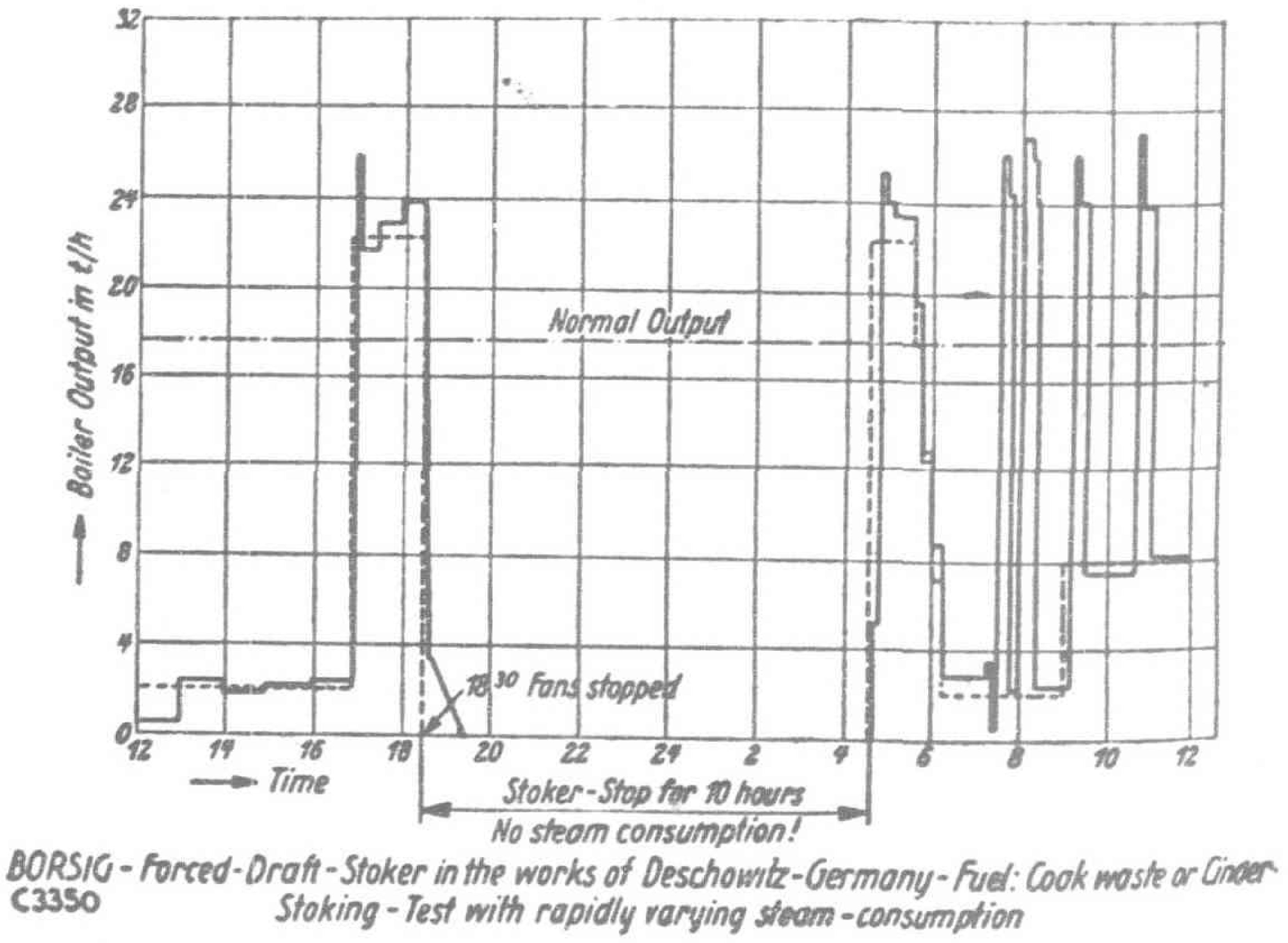


Fig. 12. Diagram showing results of a practical test of Borsig travelling grates with zones.

Chromite Mining in the Philippines*

PUBLICITY recently given the world demand for chromite, in the Philippines, has led to the staking of many mineral claims where beds or deposits of this metal are found, and to excitation of hope that holders of these claims will reap fortunes from their forehandedness. In most instances such hope will hardly be realized, for a number of reasons. The primary reason is, abundant as chromite is in the islands, and particularly on Luzon, many deposits run below commercial values. There should be about 50 per cent of chromium in the ore; this factor being determined, large quantity is essential for sustained and economic production.

Difficulties, however, do not end when you find your chromite is high enough in quality and abundant in quantity. A third question is actually mining it and getting it to tidewater and aboardship. There are deposits, otherwise potentially valuable, that lie far inland and entail no little cost of shipment to some port for export. The Philippines themselves offer no market for chromite. It is time to disillusion the public respecting possibilities in this infant industry. The market is not insatiable, and the market has to be reached.

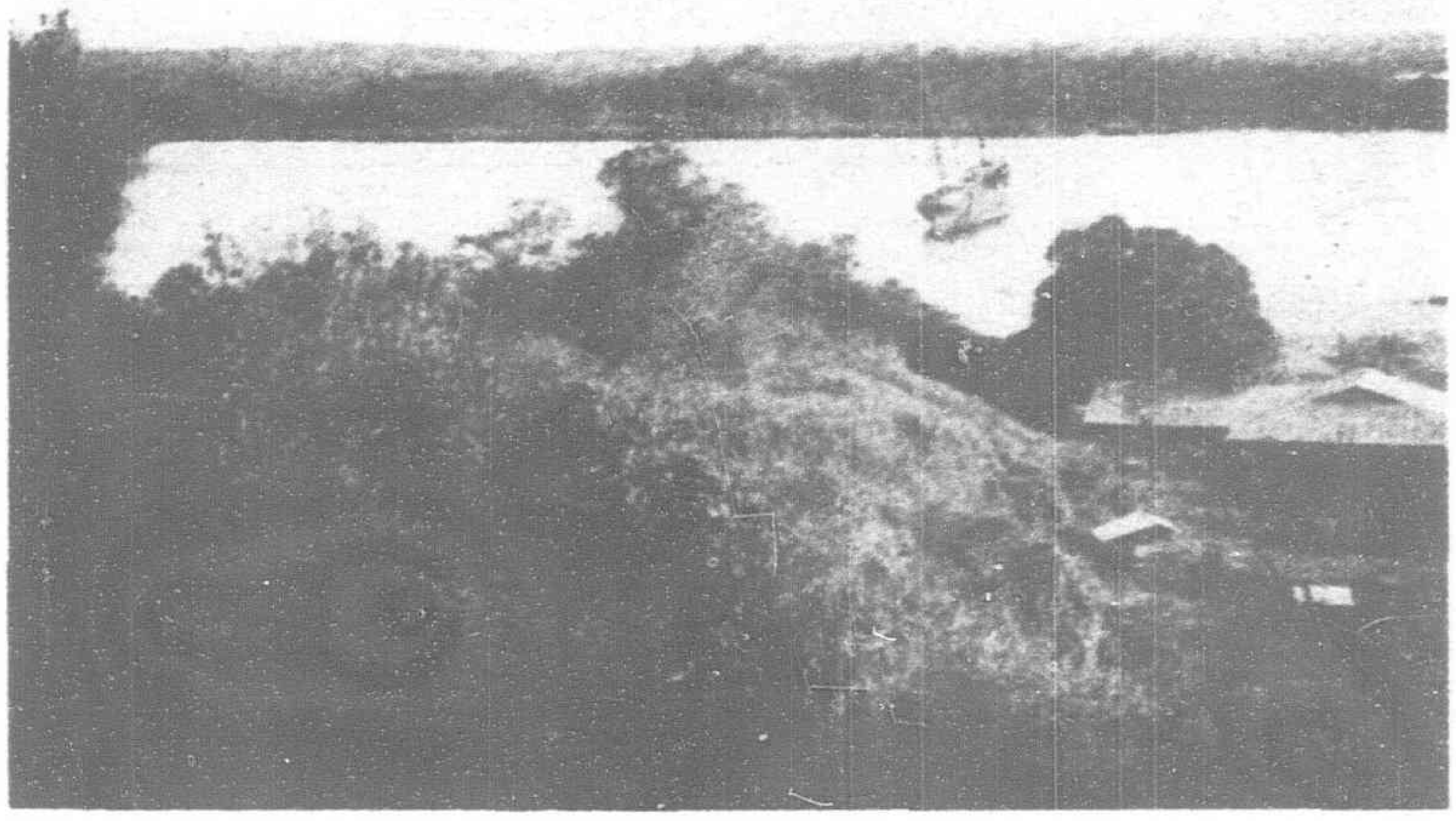
A favorable factor is, the market has potentialities of growth. It should tend to expand. Even so, in 1933 the United States herself used less than 117,000 tons of chromite ore from all sources. She got the bulk of it from Turkey, and some from Cuba, second among her suppliers. Unlike gold, for which demand is instant and universal, the marketing of chromite involves real salesmanship. It will perhaps require a marketing organization. You readily vision terminal stations of companies actually producing chromite, where supplies of it will be stored and released to the trade as wanted—all this probably based upon contracts procured by direct effort.

When you have found a marketable chromite bed, you still have to find your market. This, you will soon discover, is limited. It is ture that there are Japanese corporations willing to take what

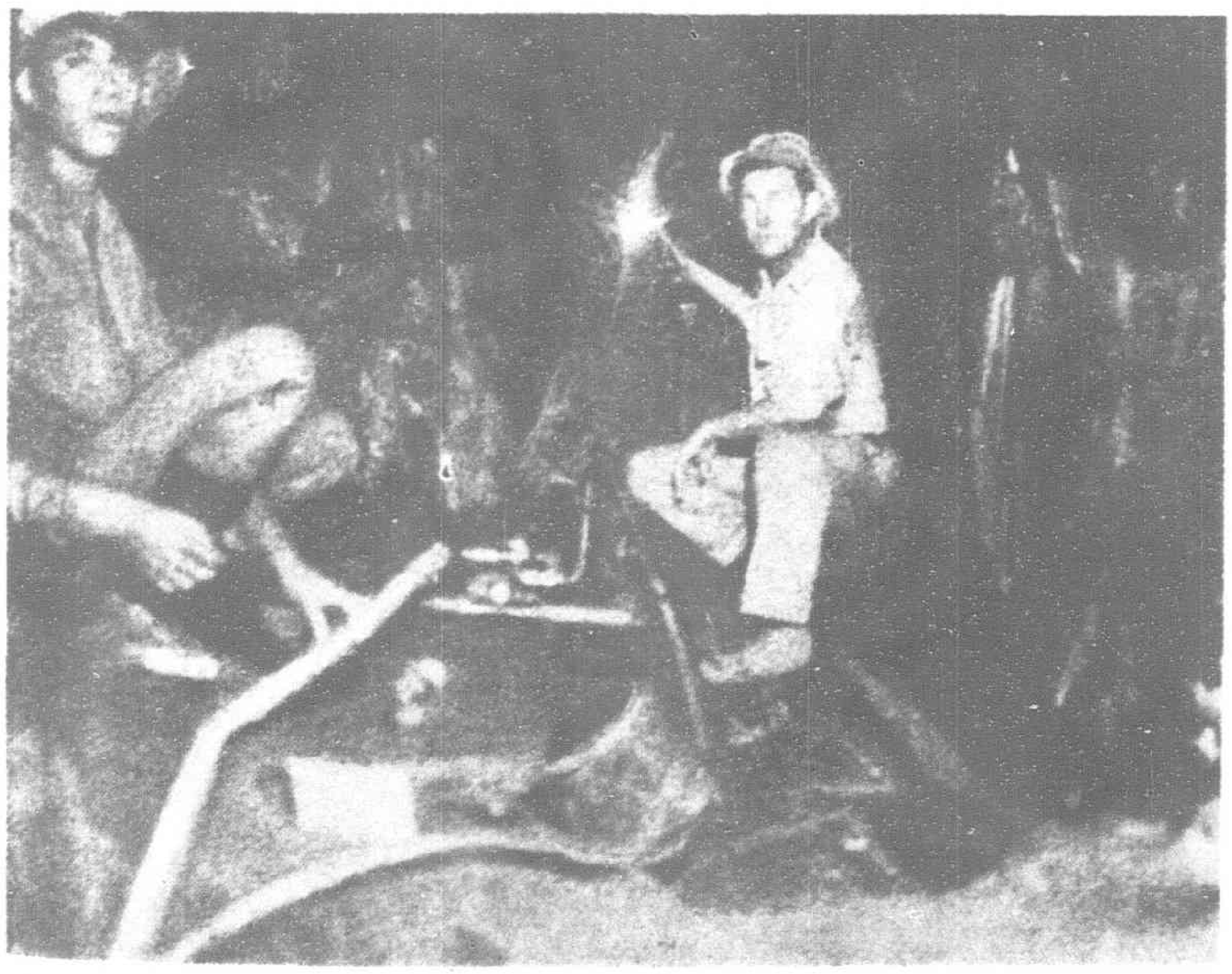
---

**The American Chamber of Commerce Journal.*

From this hill on the Benguet-Consolidated property in Zimbales, reported to contain millions of tons of Chromite Ore, the world could be supplied indefinitely



Numerous inlets like the one pictured above are available from which shipments of Chromite Ore can be made—if the world can use the Chromite



Harold Cogswell, General Superintendent of Operations for Benguit at the Masinloc Chromite property, is here inspecting the work in Tunnel No. 2. He is shining his lamp on a solid vein of high grade Chromite

The opening of Tunnel No. 1 at Masinloc. This is being driven at a low place in the Outcrop to obtain a complete horizontal section of the deposit chromite may be produced in the Philippines, but they would buy in order to sell and it is not established that profit would accrue at the price they offer.

The following table is from *Minerals Yearbook 1934*, borrowed from V. E. Lednicky, of Mineral Resources, Inc., for the purpose of compiling this comment :

Crude Chromite Imported into the United States, by Countries

Country of Origin	*1931 long tons*	*1932 long tons*	*1933*		
			Long Tons		
			Gross Weight	*Chromic Oxide Content*	*Value in Dollars*
Africa—					
Br. Union of South	5,379		986	434	$ 6,373
Fr. Algeria and Tunisia		2,206			
Portuguese Mozambique	68,291	15,496	12,200	5,730	117,583
Other	2,000				
Belgium	482				
Brazil					
Canada			49	24	584
Cuba	14,957		23,772	7,681	186,419
Germany					
Greece	28,893	16,395	11,499	4,951	166,321
Guatemala	91		2,061	1,030	37,089
India, Br	8,664	7,857	4,152	2,189	40,741
Oceania, Fr.	39,579	11,550	15,150	6,363	121,200
Turkey (Asia)	2,198	17,602	27,854	14,120	495,150
Russia	17,736	4,800	13,261	5,973	152,688
United Kingdom	24,258	13,237			
Jugoslavia			5,527	2,670	102,302
Totals	212,528	89,143	116,511	51,165	$1,426,450

Such a commerce is not only modest, it is obviously unstable and erratic. Cuba provides an ore very low in chromic oxide, 32 per cent ; after selling America nearly 15,000 tons of this in 1931, she sells her none in 1932, then sells her nearly 24,000 tons in 1933. Rhodesia's sales to America drop from 5,379 tons in 1931 to none in 1932, and only 986 in 1933. Turkey, whose supply runs 51 per cent chromic oxide, begins with 2,198 tons in 1931 and runs to 27,854 in 1933, 24 per cent of America's total chromite imports. And what do these total imports sum up, America's domestic production being below 1,000 tons in the same year ? Altogether they sum a value below P.3,000,000.

All the charges are in these figures, up to delivery from shipside. They may be counted upon to have absorbed 50 per cent of the recorded value. The market is depressed because the steel industry is depressed. Countries producing the most chromite have the smallest use for it ; when the Philippines begin producing they will be no exception to this rule. World exports were 298,000 tons in 1933, and 210,900 tons in 1932. Demand is now reviving in the United States, with the upward trend of steel orders and more manufacture of automobiles. When fewer than two million cars were made in the United States during 1932, demand ebbed very low.

Philippine chromite ore high in chromic oxide content can meet quality requirements and in course of time, due effort made, and freight charges permitting, find a place in the American market unless ores of similar quality turn up at points that might undersell the Philippines by having, for shorter hauls, to pay less freight. But it seems evident that marvellous changes of market factors must take place before the islands will market regularly and profitably all chromite they might annually produce. It seems evident, in other words, that the market could be readily oversupplied.

" Chromium," says *Minerals Yearbook 1934*, " is one of the more important metals used in the manufacture of alloy steel. It finds its principal application in the group of rust- and heat-resisting steels of which the 18-8 type (18 per cent chromium, 8 per cent nickel) is the best known. Utilization in the automobile, building, dairy, paper, petroleum and chemical industries, as well as in kitchen equipment for restaurants, hotels and hospitals, indicates the potential usefulness of this type of steel. Advances in land, air and water transportation offer new developments which increase consumption of the alloying elements.

" Welded stainless steel has been utilized recently in the fabrication of fast service trains where strength and reduced weight are desired. The legalization of beer and other alcoholic beverages has brought about the use of new stainless steel equipment in manufacturing and dispensing establishments.

" The field of alloy steels is constantly being broadened by the development of new alloys or alloying elements that produce desired properties in steel for specific uses. Titanium has been added to the 18-8 type to improve its welding properties. F. M. Beckett and Russel Franks have reported that columbium used in plain high chromium steel (in amounts eight to ten times the carbon content) and titanium (five to seven times the carbon content) render the steel soft and workable, both hot and cold. . . .

" The increasing demand for metal that can withstand corrosive attack has made the manufacture of rust-resisting steels a significant feature of the steel casting industry. Development of machinable 18-8 chrome nickel steel castings and of 18 per cent chromium castings with a fine grain, brought about by the addition of nitrogen in the form of high nitrogen ferrochrome, has been cited as a particularly interesting advance during 1933.

" During recent years stainless clad steel has been adapted to tonnage production. Mild steel clad with stainless steel is now available at a cost that will bring it within the reach of countless applications. This steel can be fabricated with the same equipment used for ordinary soft steel."

With all this development, but little more than 100,000 tons of chromite ore suffice the United States for a year. Germany, importing her whole supply, got along with 47,704 tons. France used 20,511 tons, about the sum of India's exports. Sweden used 38,981 tons. Russia produced 68,000 tons, exported 41,037 tons. The United Kingdom used 22,012 tons in 1932, from Rhodesia and India, and probably little more during 1933, exact figures not appearing in the text cited. Norway's 1932 imports were below 12,000 tons, and may be counted at about that figure in 1933. There *is* an expanding use of the ore, but a little of it goes a long way. Rhodesia has been the main source of chromite, but production dwindles there, probably because of visible supply. It is believed that the Philippines will have the advantage of greater convenience of handling from mine to ship, when they begin marketing chromite ore. Together with the quality of the ore they may be able to assure the trade, and an unfailing quantity, this should give them a position from which to make their quotations attractive.

Once started, the industry of mining and exporting chromite will probably be a permanent one of gradually rising fortune that for many years will be of moderate importance only. Its importance will grow with the amplification of uses to which the ore is put. Finding customers enough to keep a project going will, it would seem, be the real trick of the game. The day is far off when Philippine chromite, however wide its application in industry becomes, will at all compare with Philippine gold.

Several chromite development projects are under way in the Philippines, and on two properties preparations are being made for mining and shipment as soon as a market can be found. Benguet Consolidated is the pioneer and the leader in the chromite mining field, while Marsman and Company has recently acquired options on a group of claims, and plan immediate prospecting and development work.

The Florannie property, about ten miles from the coast in Camarines Norte, will probably be the first chromite producer in the Islands. Some 75,000 tons of proven high grade ore is ready for shipment, and the estimated tonnage available is around 100,000 tons. This ore averages from 48 to 59 per cent Cr_2O_3, and a shipping grade of 53 per cent is expected to be maintained. A diamond drilling campaign proved the existence of a separate lens near the main Landoc ore body, and this lens is now being developed. Equipment for the transportation of this ore to the coast is now being installed, and a tramway is being constructed to the coast. Further exploration of the remaining claim area will be resumed when the mine goes into production.

Florannie is being operated by Benguet Consolidated, as is the property of the Consolidated Mines in Zambales. Although the first chromite shipped from the Islands will undoubtedly come from Florannie, it is predicted that the bulk of future ore will come from the Zambales operations.

Benguet entered into a profit-sharing contract with Consolidated Mines on July 9, 1934, and started development operations immediately.

The Zambales deposit is believed to be one of the largest chromite ore bodies in existence. The outcrop covers about 1,000,000 square feet of rough country in which there are differences in elevation up to 500 feet. A. F. Duggleby, Benguet consulting geologist and engineer, recently described the property as likely to contain millions of tons of chromite ore. The value of this property, Duggleby stated, lies not only in the size of the deposit, although this, of course, is an important fact, but in the chemical quality of the chromite.

Chromite ore covers a wide range. Chemically, it is represented by the formula $FeO\ Cr_2O_3$—a combination of ferric oxide and chromic oxide. This is at the highest level, wherein the chromic oxide makes up, theoretically, 66 per cent of the total. The mineral then ranges downward toward the lowest point on the scale, $FeO\ Fe_2O_3$—a combination of ferric and ferrous oxides, or magnetite, from which chromium is absent. The ferric compounds are stable, and their various combinations with the chromic oxides cannot be readily reduced. Therefore, as the chromic oxide drops and the iron content is increased in the lower grade ores, they are progressively less suitable for metallurgical purposes.

The Zambales chromite ores, however, are quite different in character. In the samples thus far examined, it has been found that reduction of the chromic oxide content below the peak levels are taken up, not by an increase in the iron content, but by an increase in the native rock. Thus metallurgical handling is virtually unaffected, since all that will be required for utilization of lower grade ores is a simple concentration process. The pulverized ore, according to Duggleby, can easily be briqueted after concentration for commercial handling.

George Scarfe, geologist and mining expert for Benguet, has done considerable preliminary prospecting and development work on the Zambales chromite, as has Duggleby. Harold Cogswell was placed in charge of the development work some months ago, and is now on the property as general superintendent.

Under Cogswell's supervision a road has been built some twenty kilometers in from the town of Masinloc, and machinery is being hauled over it for the mine equipment. This road is quite passable for trucks, and should stay open except in the most severe storms.

Two tunnels are being driven to develop the ore body fully and to get the mine in shape for production by the end of 1935. They were started from the lowest points of the outcrop, with the idea of obtaining a complete horizontal section of the deposit. Diamond drilling will be started soon, so that the extent of the entire ore body can be determined, and plans for subsequent mining determined.

A house has been built for Cogswell and his family, and a few other buildings for general uses. Mess houses, bodegas and all the other construction work necessary for a mine camp have been planned and will be erected soon. It is possible that a landing field will be cleared near the tunnel openings, so that air transportation can be used for personnel, visitors and small equipment.

Both tunnels have been in ore for some time, and Tunnel Number Two in particular has shown rich assays. At the entrance to this tunnel there is a large exposed surface of chromite. Nearly 100 laborers are employed on the property at present, and this number will probably be increased within the near future.

Transportation of the ore from the mine to a shipping point will probably be effected by means of a railroad down the Posoy River. There is a wide river bed from the ocean up to the mine site, and a gradual grade will make the task of constructing a road bed possible. Shipping sites on the coast are numerous. Two kilometers from the entrance of the mine road, near Masinloc, a harbor is already being used by a Masinloc lumber company. Numerous covers in the vicinity, with deep water and well-protected inlets, will make it practical either to construct a loading pier or to load by means of lighters.

Benguet also has a prospecting contract with Cadwaller and Company, regarding deposits of chromite in the Southern Islands. A prospecting campaign extending over several months found indications of substantial tonnage of high grade chromite practically at tidewater, according to Benguet engineers. A Benguet geologist is now examining the property preparatory to active development.

The claims of Marsman and Company are in Zambales. J. O. Greenan, consulting engineer for the company, did considerable preliminary work on the property, and J. E. Fyfe has been placed in charge of active development to start soon.

The future of the chromite mining industry depends to a great extent upon the result of a trip being made by Judge John W. Haussermann, President and General Manager of Benguet Consolidated, to the United States. The purpose of this trip was announced as to study the chromite market possibilities. It has been reported that he might go to Europe to investigate possibilities there, should he not find suitable connections in the States.

It is expected, however, that he will secure contracts in the United States, and that shipments of chromite from Florannie will start across the Pacific within a few months, to be followed by ore from the Consolidated Mines property.

JAPANESE AVIATION PLAN OUTLINED

The Communications Ministry was reported by the *Nichi Nichi* to be drafting a 15-year plan for the development of international air routes that will involve an expenditure of Y.250,000,000.

The plan will be submitted to the Commission for Investigation of Aeronautic Enterprises, of which the Communications Minister, Mr. Takejiro Tokonami, is the chairman. The plan is expected to include the following projects.

(1) Extension of the Fukuoka-Formosa route to connect with Manila, Singapore and Batavia.

(2) Extension of the Tokyo-Palao route to connect with the trans-Pacific service of Pan-American Airways.

(3) A new route between either Osaka or Tokyo and Vladivostock to connect with the trans-Siberian air service.

(4) A new route from Nemuro in Hokkaido to Petropavlovsk to connect with the Soviet air services and also with the Fairbanks-Nome line of the Pacific-American Airways.

(5) A new route from Hokkaido by way of Toyohara in Saghalien to Alexandrovsk or Vladivostock.

Construction of an air tunnel comparable to that of the Langley Aerodrome will also be included in the proposals.

Besides Mr. Tokonami, other members of the Commission to which the report will be submitted include the Foreign Vice-Minister, Mr. Mamoru Shigemitsu, the Finance Vice-Minister, Mr. Juichi Tsushima, the War Vice-Minister, Lieutenant-General Toranosuke Hashimoto, the Education Vice-Minister, Mr. Nagaharu Mibe, the Commerce Vice-Minister, Mr. Shinji Yoshino, the Communication Vice-Minister, Mr. Hachiro Ohashi and prominent scholars in aeronautics.

Air transport enterprises of foreign nations are commented on in the report as follows :

England : The Imperial Airways Company has been converted to a policy of "speed," and is going to shorten the trip between London and Singapore from nine days to four days. It is contemplating also an extension of the route as far as Hongkong.

France : Air France Company is contemplating extension of the Paris-Saigon route to Hanoi, Yunnan and Shanghai.

Netherlands : The K.L.M. (Royal Dutch Airways) is considering speeding up the Amsterdam-Batavia service to 3½ days and extending the service to Manila.

Germany : Germany may inaugurate a new air route to China by way of India.

Italy : Four air transport companies were amalgamated recently and the new concern may extend its service to the Far East.

America : Pan-American Airways has preparations completed for a trial flight across the Pacific in July. It will inaugurate the service between San Francisco and Manila and extend the route to Canton to connect with the Shanghai-Canton service of the Chinese Air Navigation Company.

Automatic Telephones for Ceylon

Details have been published of a project to replace the existing manual telephone system in Ceylon with an up-to-date automatic service and the project has been placed before the State Council at Colombo in the form of a report by Mr. E. C. Villiers, Acting Minister of Communications.

The following are material extracts from the report :—

The plant—and in particular this refers to the Central Telephone Exchange in Colombo—which was seriously out of date and inadequate at the time of the depression, has been growing older and more ineffective ever since.

The present system generally adopted in Colombo is known as the Magneto Manual System. It is hardly necessary to point out that this system, besides being antiquated, is expensive in regard to the wages which have to be paid. The equipment itself is mostly over 20 years in service, and has had constantly to be patched up.

But in addition to this the capacity of the existing switchboard is insufficient for the increasing needs of Colombo, and it is anticipated that by the end of the current year, or possibly early in 1936, it will be necessary to refuse further applications for connection. Such a position is one which should be avoided at all costs. To remedy this state of affairs it is proposed to install automatic equipment in the Colombo Central Exchange, with subsidiary automatics at Havelock Town and Maradana.

To modernize the system in Colombo it is proposed to replace the existing manual system by automatics. By this latter system the person calling up another subscriber manipulates a dial on his instrument. This immediately, and without the need of any operator at the Telephone Exchange, connects him with the person he requires. This system is already in operation in a very minor degree in Colombo. The Post Office telephones as well as all those of the Public Works and Survey Departments are connected to such a system. It will be readily seen that if this system is made general the following advantages will result :—

(1) Reduction in the cost of management, as the need for operators at the Central Exchange will be almost entirely eliminated. This will not entail throwing employees out of work as they seldom stay for any length of time, and there will always be employment for a few operators to manage the Trunk System and Junction Lines,
(2) Less delay in connecting one subscriber to another, and
(3) Automatic recording of the number of calls made by each subscriber.

Message Rate System

In connection with the third item above it is considered advisable to point out that, with the introduction of Automatics in Colombo, it will be possible to introduce the "message rate" system of payment. This system is now universally adopted throughout the modern world, and bases the cost of the telephone to the subscriber in accordance with the use made of it. By this method the subscriber pays an annual charge, and, in addition, is called upon to pay a small rate for every call put through, such calls being automatically recorded as stated above.

Apart from the position in Colombo there is urgent need to extend the Telephone System in various parts of the Island. In many towns of sufficient importance there are no telephonic facilities at all, while in others the telephone system is under private control and is unsatisfactory in operation. The Executive Committee considers it should be the policy of Government to render the availability of telephones as wide as possible, and also keep it under its own control. With this end in view it is suggested that the various small telephone systems now under private management should be taken over and standardized by Government.

It will doubtless be realized that the whole of this project will cost a considerable amount of money. An estimate prepared by the Post and Telegraph Department places this figure at nearly three million rupees.

It is the proposal of the Executive Committee that this expenditure should be spread over a period of five years. Owing to the fact that the provision of automatics in Colombo to replace the antiquated and worn-out system now installed will form a considerable portion of the expenditure required, it will be necessary that the provision to be made in the first year or so should be very much larger than that required in subsequent years. It is anticipated that the sum required up to the end of the financial year 1935-36 will amount to Rs. 1,372,000, while in the following three years the expenditure will be in the neighborhood of four lakhs. In 1939-40 this will drop to under three lakhs.

Owing to the great urgency for steps to be taken to prevent a breakdown and to meet anticipated applications for connection to the telephone system in Colombo, the Executive Committee proposes placing before the State Council an application for supplementary provision, subject to the State Council agreeing with its proposals in this report. It must be emphasized that this scheme will prove remunerative from the moment of installation.

The Executive Committee of Communications and Works accordingly requests the sanction of the State Council to its proposal for modernizing and extending the present Ceylon Telephone System over a period of about five years.

Changes and Cost

The following are the various works on which it is proposed this expenditure should be incurred :—

(*a*) *Replacing the present magneto manual system by an automatic one in the Colombo Cental Exchange area*	Rs.920,400
This proposal may be divided up into the following items :—	
Extension of the existing Central Telegraph Building to house the new automatic equipment	275,000
Purchase of automatic equipment (4,000 lines fitted, ultimate capacity 10,000 lines) and installing same	580,400
Purchase of necessary humidifying plant for the Central Exchange, and installing same	17,000
Purchase of manual equipment, Central Exchange (Trunk Positions)	10,000
Diverting the existing cables to the new building which are at present brought into the C.T.O. building ..	30,000
Replacing Magneto private Branch Exchanges in Central area for others suitable for automatic working ..	8,000
(*b*) *New Post Office and Automatic Exchange at Havelock Town in place of the existing manual system* . ..	377,000
This proposal may be subdivided into the following items :—	
Estimated cost of site to be purchased for Post Office and automatic exchange for Havelock Town ..	25,000
Estimated cost of a suitable building for a Post Office and Exchange at Havelock Town	120,000
Purchase of automatic equipment (700 lines fitted, ultimate capacity 2,500 lines) at Havelock Town, and installing same	107,000
Purchase of necessary humidifying plant at Havelock Town, and installing same	14,000
Providing and laying new junction cable (armored) between Maradana and Havelock Town Exchanges	36,000
Conversion of Private Branch Exchanges from C.B. to automatic working in the Havelock Town area ..	5,000
Providing and laying new junction cable (armored) between Havelock Town and Central Exchanges ..	70,000
(*c*) *New Post Office and Automatic Exchange at Maradana in place of the existing manual system*	291,000
This proposal may be subdivided into the following items :—	
Estimated cost of a new Post Office and Automatic Exchange building at Maradana (site already secured)..	120,000
Purchase of automatic equipment (700 lines fitted, ultimate capacity 2,500 lines) at Maradana, and installing same	107,000

(Continued on page 269)

Sulzer Engines of New Design for the South Manchuria Railway

The illustrations show front and back views of Sulzer Diesel engines, four of which were recently supplied to the South Manchuria Railway Co. These engines are intended for fitting in rail cars and each will be coupled to a D.C. dynamo. They were built in the Sulzer works at Winterthur, the dynamos and the cars in Japan. Each of these six-cylinder engines develops at one hour rating 500 b.h.p. at 900 r.p.m. and continuously 460 b.h.p. at 830 r.p.m. The fuel consumption determined on the test bed was

	900 r.p.m.	*830 r.p.m.*
at 4/4 load	175	171 gr/b.h.p.—hour
,, 3/4 load	180	178

The output was measured with an hydraulic brake and an electric generator.

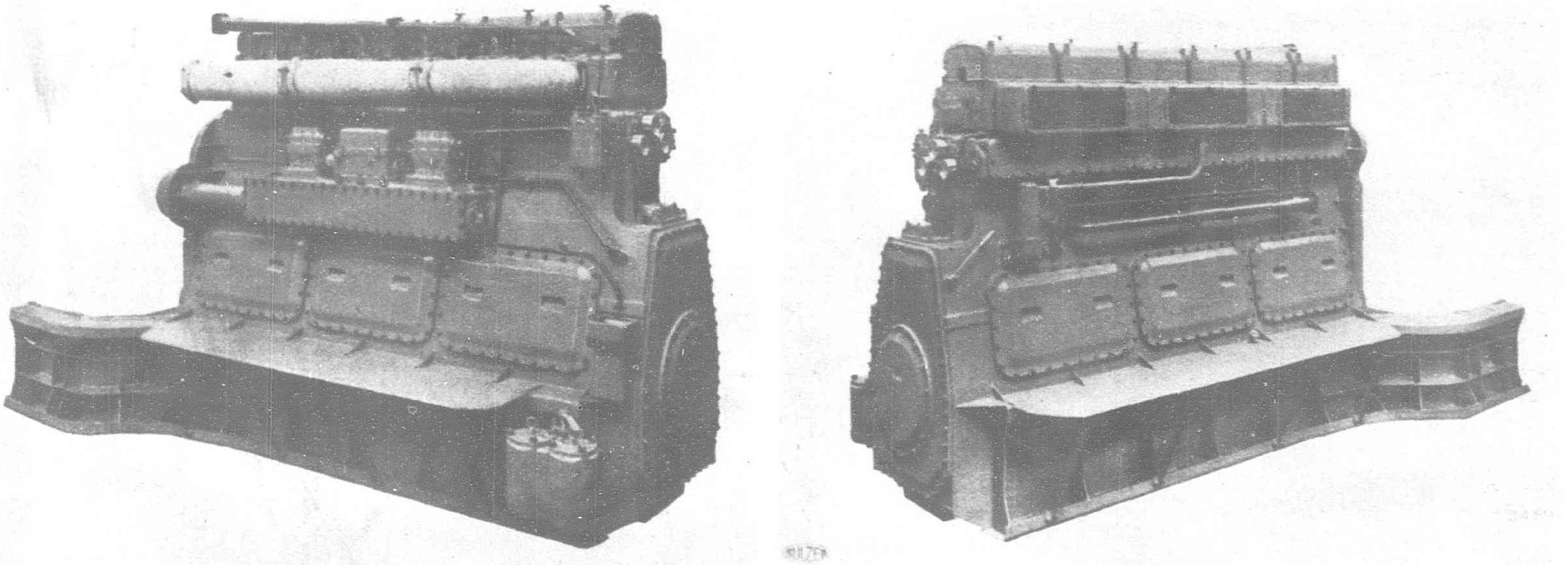
As can be seen from the illustrations, this new type of engine is of very compact construction. In order to reduce the weight, cylinder block and bedplate consist of a combination of cast steel elements and steel plate, the former being welded to the latter as in former Sulzer constructions. The bedplate is designed as a frame and is extended and widened at one end for taking the dynamo. Great resistance to deformation through internal forces and momentum is obtained by making this frame in one piece and of a good depth. Particular attention was paid to obtaining perfect transmission of the forces arising in the cylinders from the combustion and acceleration pressures to the crankshaft bearings. For this purpose each bearing support of the crankshaft is designed as a U-shaped strap, which has its upper ends firmly secured to the cylinder block. The cylinder block itself consists in its upper part of a cast steel transverse frame; on to which the side walls are welded, whilst the cylinder liners are inserted into it from above.

To facilitate inspection, each cylinder has a separate cover in which the suction and exhaust valves and also a centrally located fuel valve are fitted. These covers are light and can easily be removed without having to dismantle the valve gear. The fuel valve being arranged in the axis of the cylinder gives symmetrical conditions for the fuel injection and also for the heat stressing of the aluminium piston, which is pressed from one piece of metal.

The cam shaft is supported in bearings at the side of the cylinder block and is direct driven from the rear end of the crankshaft by means of toothed gearing. As can be seen from the illustrations, a special horizontal shaft runs along the side of the cylinder block and serves for driving the fuel pumps and the governor. The illustration shows the fuel pumps, which are arranged in two blocks at both sides of the governor. The latter can be controlled from the driver's cab in order to adjust the revolutions of the engine to one of three different service speeds.

The design of the engine described above allows normal overhauls to be made without having to dismantle the engine. Even at main overhauls this is not absolutely necessary, since all parts are easily accessible and removable. The whole engine is automatically lubricated and works in every respect independent of the driver. The moving parts are protected from dust, and the combustion air is drawn in through a filter fitted in front of the suction branches, so that no dust can get into the lubricating system in this way. Twin lubricating oil filters are also provided. They can be replaced or used alternately while the engine is running. Particularly low lubricating oil consumption is ensured by special design of the piston.

Other engines of similar construction, but for smaller output are under construction by Sulzer Brothers for four rail cars for the Ferrocarril Provincial, Buenos Aires. This firm is also at present building the engines for two high-speed rail cars for the Swiss Federal Railways. A series of 10 engines of the type described above, with an output of 400 b.h.p. at 1,000 r.p.m. are being built by Messrs. Sir W. G. Armstrong, Whitworth & Co. (Engineers) Ltd. for the London, Midland and Scottish Railway. The latter firm is also at present building nine engines, each developing 290 b.h.p. at 1,200 r.p.m., for the Central Argentine Railway.



Showing front and back views of Sulzer Diesel Engines recently supplied to the South Manchuria Railway Company

---

FUSHUN-YINGKOW CANAL PLANNED

The building of a canal from Fushun to Yingkow is contemplated, a message from Mukden states. According to the Japanese plans this canal will be constructed at an estimated cost of $30,000,000 and is to be completed in five years. It will start at Wushun, connect with the Hun River, pass through Mukden, join the Liao River and terminate at Yingkow. Of the total estimated expenses it is stated that $2,500,000 will be used in excavation work, $3,000,000 in building the wharf at Yingkow, while the remainder will be expended on constructing water reservoirs, dikes and ships.

Commodities to be transported through this contemplated canal will be Fushun coal, Anshan iron, Yingkow salt and other special products of Liaoning Province.

Currents from the water reservoirs into the canal will be utilized to generate electricity, which in turn will be employed to exploit and irrigate the farm lands along the banks of the canal.

The East Indian Network*

About the end of March cables from Singapore and Manila stated that sites for six new aerodromes had been selected along the North-West coast of Borneo for a possible Imperial air route between Singapore and Hongkong by way of the Philippine Islands, which will be the junction for the Pan American flying-boat service across the Pacific. The announcement was made by Col. J. F. Turner, R.E., Director of Works and Buildings in the Air Ministry. At the same time Cmr. W. H. Tetenburg, of the Royal Netherlands Navy, was surveying the line from Sourabaya, up the East coast of Borneo to the Philippines.

The latest news is that the Netherlands Indies Government has given the K.N.I.L.M. permission to run a trial service from Java to Balikpapan and Tarakan. This is to start as soon as the aerodromes there and at Martapoera (for Banjermasin) are ready. Balikpapan and Tarakan are refinery and shipping centers of the Bataafsche Petroleum Maatschappij (the Netherlands Shell Co.), and as they are busy centers there is good hope of traffic. The aerodrome for Balikpapan is Manggar. The Netherlands Indies Government are constructing the aerodrome at Martapoera to serve Banjermasin and, according to the annual report of the K.N.I.L.M., the Shell company are providing the other two landing grounds. The service is expected to start in the latter half of this year.

No decision is reached yet about an extension to the Philippines, for we hear that negotiations are going on between the Governments of Holland and the United States. Obviously, the aim is to extend from Tarakan over the islands of the Sulu Archipelago to Zamboanga, which is the Southern terminus of the air lines in the Philippines run by the Iloilo Negros Company.

The aerodrome at Macassar (the place which forced the production of the antimacassar of our grandparents) in Celebes is now practically ready. This suggests an air line between that town and Java. At the request of the Macassar community the K.N.I.L.M. are starting a trial service for three months, by way of Bali. They have Government permission and are beginning at once. Important schemes of the large oil companies for an air survey of part of New Guinea are providing another opportunity for the increased use of aeroplanes.

In 1934 the Netherlands Indies Government could not provide funds to construct landing grounds for new air services, but private initiative has helped. In this way Brastagi has been given an aerodrome which was opened on September 16, on which occasion the R.A.F. from Singapore joined in a display. Also at Sabang a landing ground, only suitable for small aeroplanes at present, was opened in November. By the end of 1934 Macassar and Padang grounds were nearly ready and a site had been chosen at Malang.

There has been more agitation for a new aerodrome for Batavia, situated nearer to the center of the town, and a plan is now taking definite shape. The K.N.I.L.M. will bear part of the cost. At the end of last year this company had four Fokker F.VII b monoplanes (three Lynxes), two other F.VII bs (three Titans) and two F.XIIs (three Wasp Seniors). They have now decided to buy three Douglas D.C.2s.

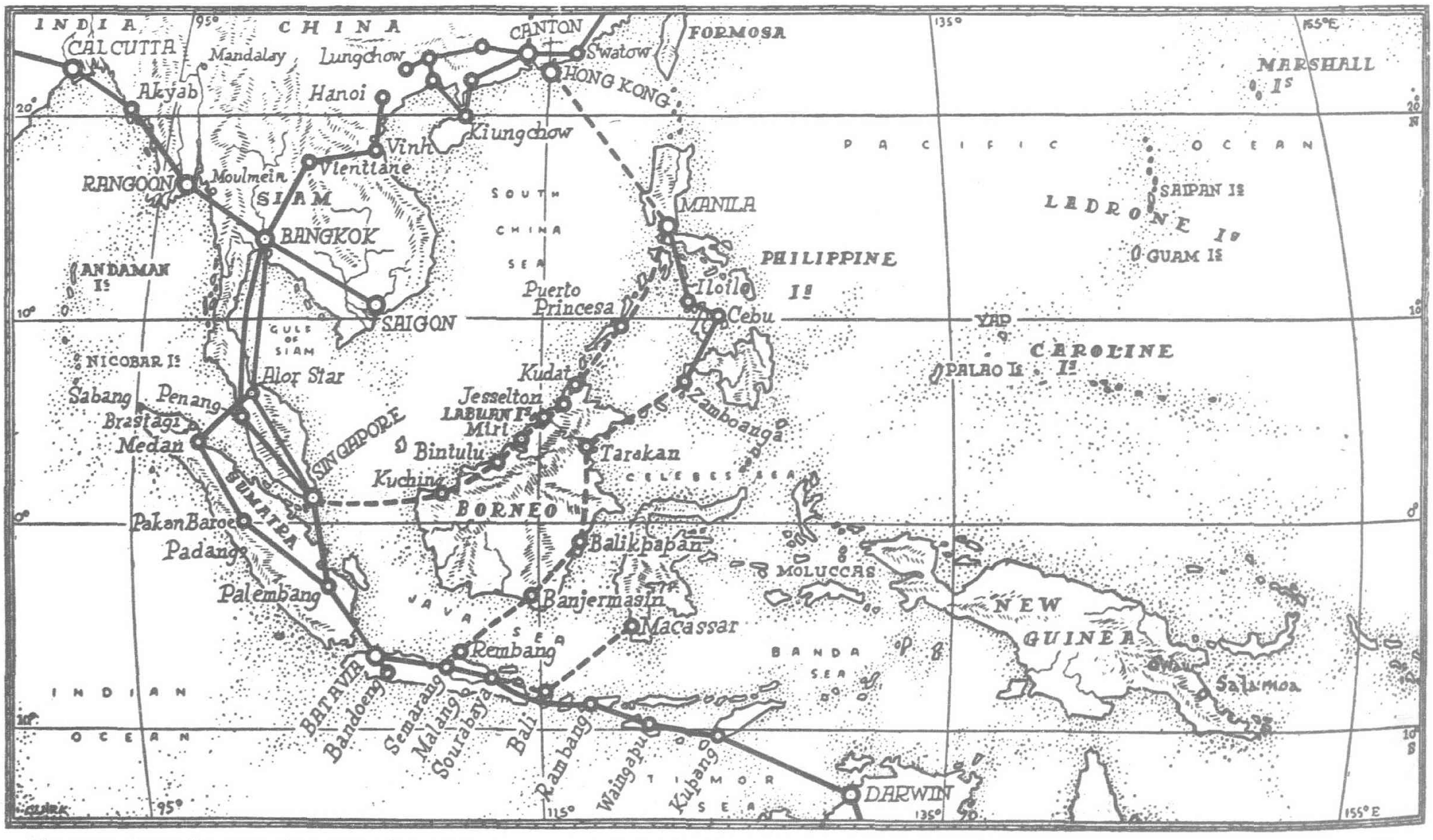
On the regular services the K.N.I.L.M. carried 27 per cent more passengers last year than in 1933, the figure for which was about level with 1932. The 1934 totals were 13,313 passengers on regular services, plus 4,317 on their flights, compared with 10,524 and 2,554 in 1933. The freight total rose in 1934 by 5,000 kg. (or 7.25 per cent) to 74,708 kg. and the mail total rose 3,000 kg. (or about 12 per cent), to 27,564 kg.

The Batavia-Bandoeing line (two and three times daily) continues to carry most of the passengers (8,027 in 1934) and the Batavia Sourabaya line comes next with 3,013 passengers. The biggest percentage increase (51 per cent) was on the Batavia-Medan line. Regularity in 1934 was 100 per cent. There were 3,106 trips totalling 5,852 flying hours and 956,466 km.

The Amsterdam-Batavia line of the K.L.M. carried 15 per cent more passengers last year than in 1933. Mail from the Netherlands Indies averaged 299 kg. per flight against 262 kg. in 1933. This line is being flown twice weekly from June 12, and Douglas machines are to be used.

---

*The Aeroplane.



The map shows the new air routes planned by British and Netherlands interests in the East Indies. Remembering that Formosa, The Marshalls, the Ladrones and the Carolines are Japanese mandated possessions and that Guam is on the American route from California and Hawaii to the Philippines, one can visualize the stratagic importance of these lines in a defense of the oil islands by an Anglo-Dutch-American force based on Singapore

Electrical Thermal Storage System with Low Voltage Electrode Water-Heaters

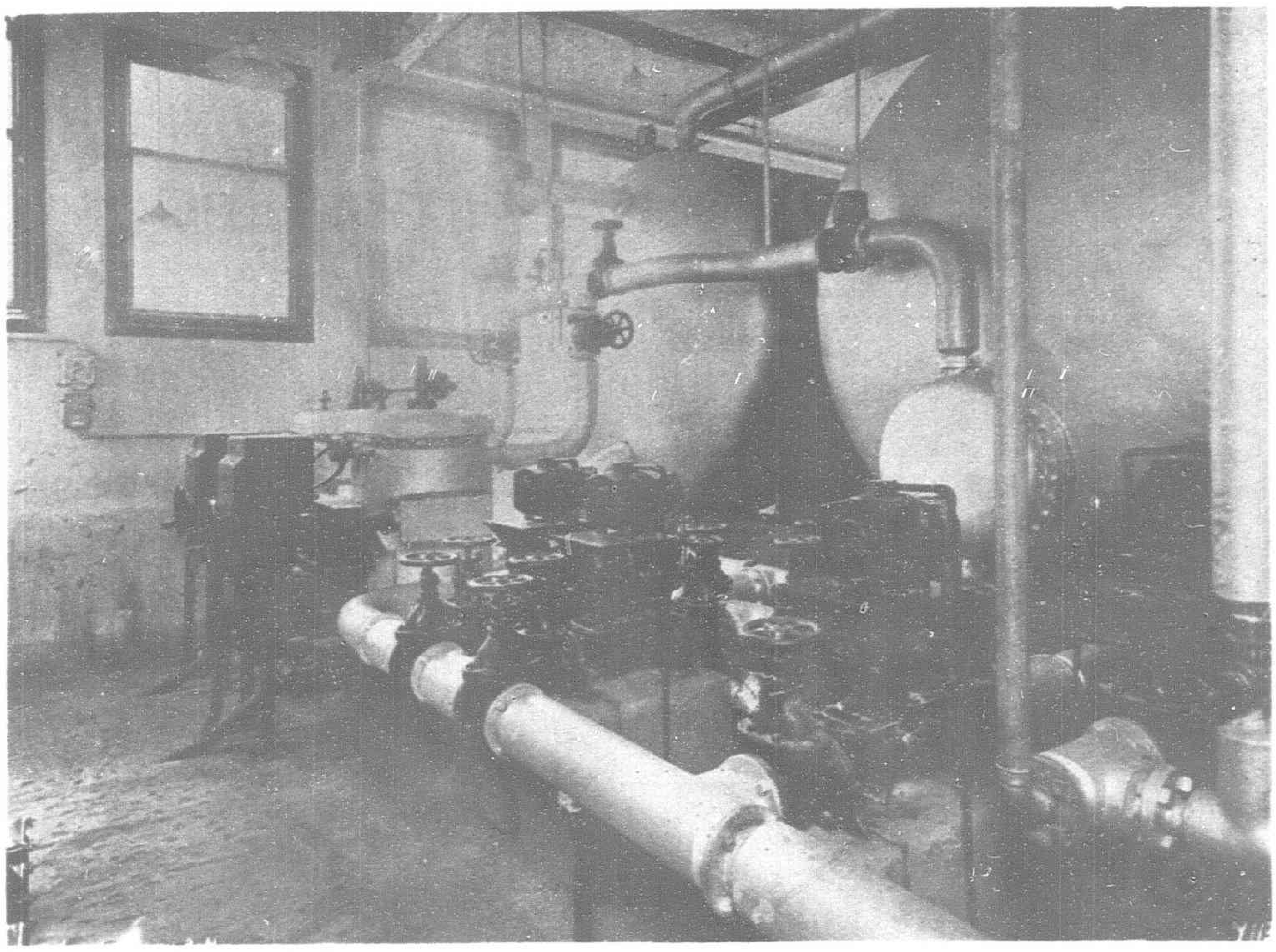


Fig. 1.—Showing arrangement of two 200 kw. 400-volt, 3-phase Electrode Water Heaters, Circulating Pumps, and Building and Domestic Supply Storage Vessels installed at Belfast Union Jubilee Hospital

THE electrical thermal-storage system of heating has steadily increased in popularity, and its application to the warming of buildings has in particular been attended with remarkable success. In consequence, many fine electrical central-warming plants are already in operation, and because of their sound performance and high efficiency such equipment is coming more and more into consideration for buildings of all kinds, from large town and country houses right up to elaborate public undertakings. Its reliability and cleanliness, as well as the exceptional advantages of its automatic control, make a strong appeal to any engineer or architect who happens to be concerned with the heating of these places.

The benefits obtainable in this way are particularly important for hospitals; and the recently-completed all-electric Belfast Union Jubilee Maternity Hospital includes in its equipment a central-warming and domestic hot water plant of outstanding interest. The hospital heating-plant, the switchgear, and the control-panels are shown in Figs. 1 and 2.

Reyrolle low-voltage electrode water-heaters were chosen, and of these there are two 400-volt 3-phase units, each with a maximum load of 200 kilowatts, which is equivalent to 683,000 B.Th.U. per hour. A detailed specification of these units and of the switchgear and control-panels is given in the following.

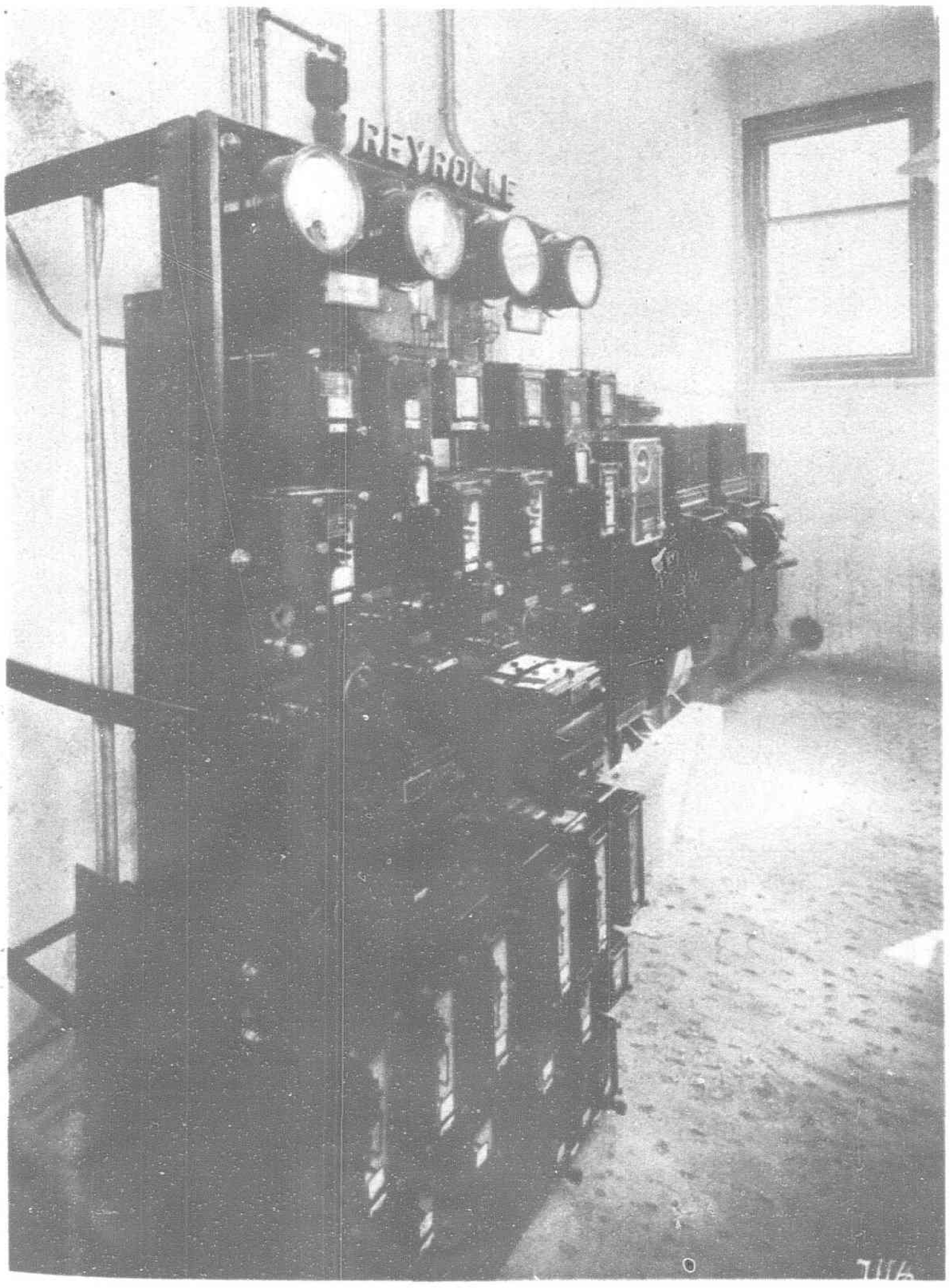


Fig. 2.—Showing arrangement of Switchgear comprising two Control Panels and Main Circuit-Breakers

There are two storage-vessels, each with a capacity of 4,000 gallons. One serves to heat the building during the peak or non-charging period, and the other provides the domestic hot water. An interesting point about the latter is that it is hydraulically isolated from the heaters, the transfer of heat being by means of an exchanger-coil built into the vessel. The storage-temperatures of the vessels are not alike, being 220°F. and 160°F. respectively; and, since both of them may be connected to one or both of the heaters at the same time, special magnetic valves, operating as described below, are fitted in their flow-pipes. Each is controlled by a thermostat, and the arrangement is such that when the temperature of the water in either vessel reaches a value corresponding to the setting of the thermostat the magnetic valve closes and stops the flow to that vessel. When both valves are closed, the heater-load is reduced automatically to its minimum value and the circuit-breakers controlling the supply to the heaters are opened; and when, owing to the demand the temperature of the water in either vessel falls below the thermostat-setting the magnetic valve reopens and the heater automatically goes on load again. The economy of this arrangement is obvious: it is, in fact, a maximum.

It will be seen from the layout plan shown in Fig. 4 that there are three pumps, and these are so arranged that one serves the building system and another the heaters, with the third as a standby for either of the other two. In an emergency, one pump is capable of serving both sections.

The demand for domestic hot water is of course continuous, whereas the building has to be heated as a rule only in winter. On this account, the auxiliary switching-controls are so arranged that the magnetic valve in the flow-pipe to the storage-vessel for the building can be de-energized, and so closed, by means of a single tumbler-switch, without interfering in any way with the automatic working of the plant when supplying heat for domestic hot water.

A distinctive feature of this hospital equipment is the arrangement of the two control-panels. Each of these controls one heater, and they are duplicates of each other, except that the time-switch is common to both. They carry all the indicating, load-controlling, protective, and auxiliary instruments for the whole installation;

and such a system of complete centralization of control is strongly to be recommended for plant of this kind, since it requires a minimum of attention during commissioning and on all occasions when demonstrations or modifications in the operation of the plant are required, and also reduces to the smallest possible amount both normal and emergency maintenance.

In addition to the main heating-plant described above, there is a 35 kw. 400-volt 3-phase totally-automatic Reyrolle electrode steam-raiser in the hospital to provide steam for the drum-type dressings-sterilizers; and the Nurses' Home adjoining the hospital is also warmed and supplied with hot water from Reyrolle thermal-storage plant using immersion-type heaters.

Water Heaters

The water-heaters are of the low-voltage electrode type, and are suitable for direct connection to a 400-volt 3-phase 4 wire 50-cycle supply. There are two identical units, each taking a maximum of 200 kw. when operating at full load, and capable of regulation down to 30 per cent of full load by means of moving porcelain shields. The shields are of the plate type, and are carried on a common framework mechanically coupled to the operating-motor through a stainless-steel rack-and-pinion mechanism inside the heater-shell and a reduction-gear mounted externally on a bracket attached solidly to the side of the shell. A hand-wheel is also fitted so that, if required, the load-regulation may be manual as well as automatic.

The electrode terminals are brought out at the base of the heater through special heat-resisting bushes, and are connected by robust copper bus-bars to a diving-box mounted on the side of the shell at an angle suited to the run of the supply-cable. All the main and auxiliary connectors are totally enclosed in earthed metal housings. All external parts subject to wear in the course of normal service are easily removable and replaceable, and each heater is complete with the following standard fittings: a spring-loaded relief-valve, an air-cock, an inlet-valve, an outlet-valve, a drain-valve, a safety pressure-switch, and a safety thermostat.

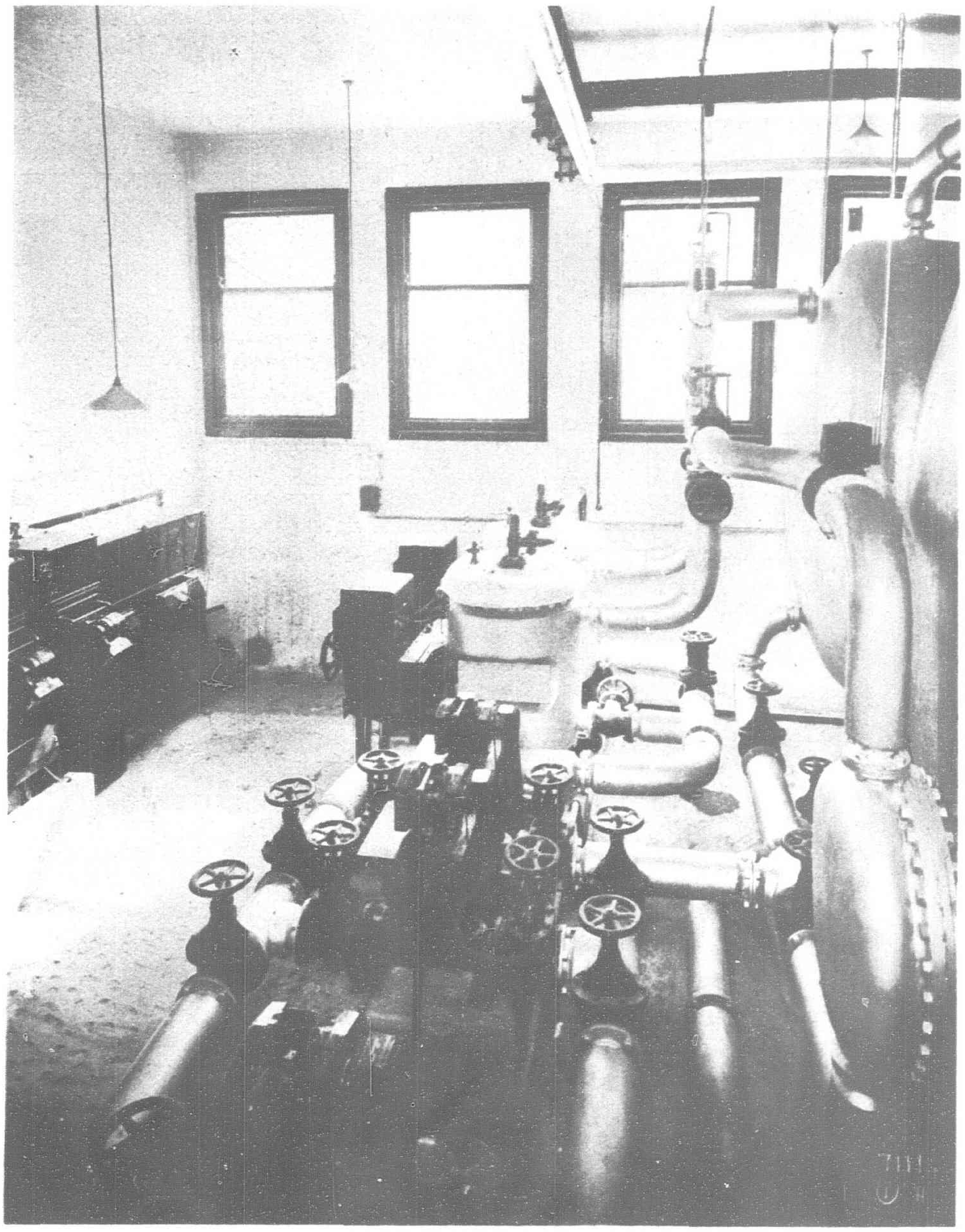


Fig. 3.—Another view showing arrangement of two 200 kw. 400-volt, 3-phase Electrode Water Heaters

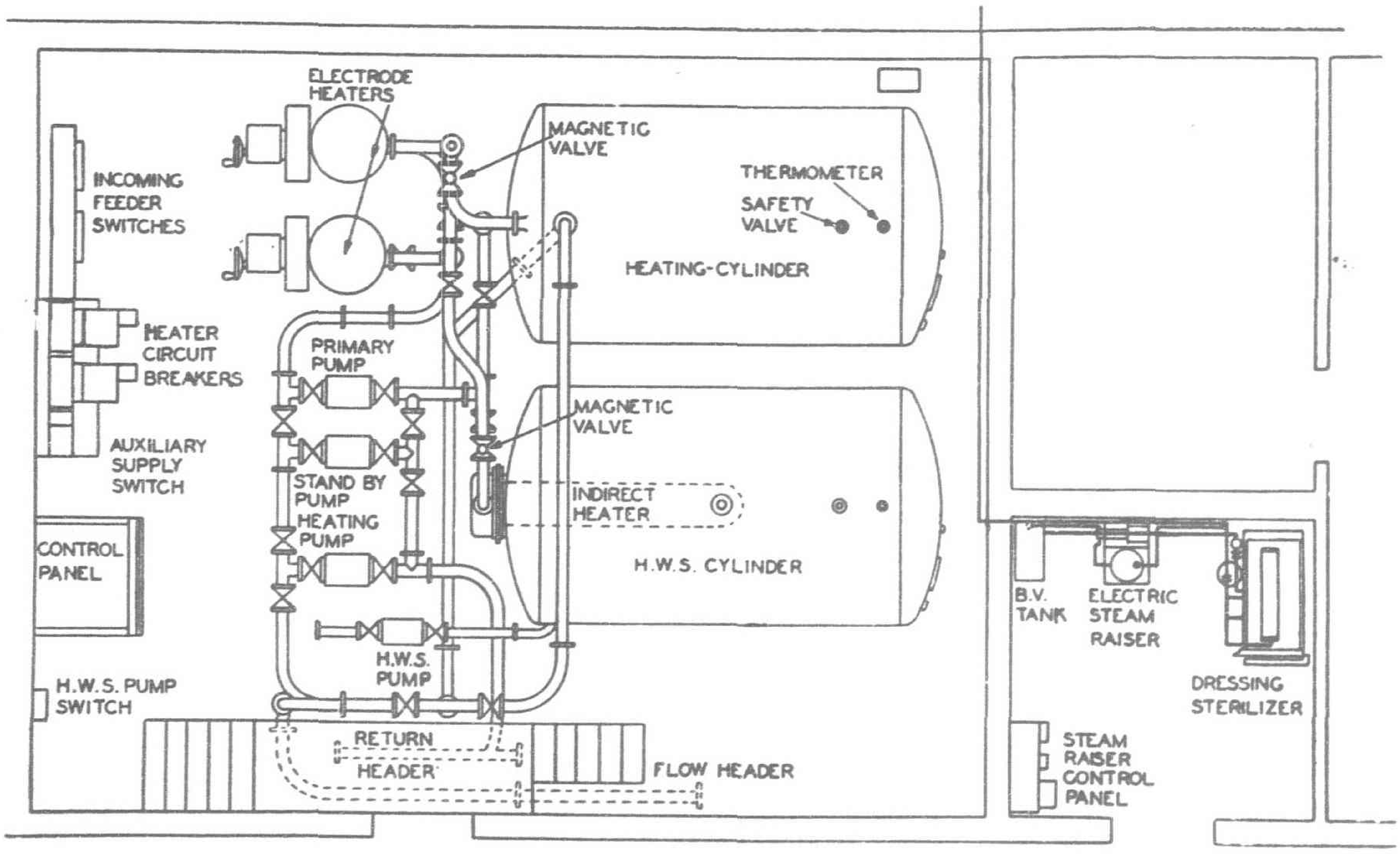


Fig. 4.—Showing Lay-Out Plan. There are three pumps so arranged that one serves the Building System, another the Heaters with a third as a standby for either of the other two

Main Switchgear

The main switchgear consists of two 400 ampere Type "E" metal-clad horizontal-draw-out pillar-tpye circuit-breakers, and one Type 30-ampere metal-clad interlocked switch-and-fuse unit.

The Type "E" circuit-breakers each comprise: (*a*) a cast iron pedestal, a plug-in chamber, and a bus-bar chamber containing three line and one neutral copper bus-bars of suitable section run-in solid with compound; (*b*) a triple-pole free-handle motor-operated oil-immersed circuit-breaker with a welded boiler-plate tank; (*c*) three current-transformers of ratio 400/5 mounted in the switch-hood, an A.C. auxiliary trip-coil, an under-voltage release, and alarm-bell contacts; (*d*) an incoming-cable dividing-box mounted an the underside of the plug-in chamber complete with a gland and a clamp to take the p.i.l.c. and s.w.a. supply-cable; and (*e*) a label, suitably inscribed.

The 30-ampere Type ⊢⊣ switch-and-fuse unit is mounted below a section of the bus-bar chamber at the left-hand end of the board, and the right-hand end of the bus-bar chamber adjoins the incoming-feeder isolating switchgear.

Control-Panels

Two control-panels are provided for the remote control, protection, and operation of the switchgear and heaters, for the regulation of the heaters, and for the remote control of the pumps. Each panel comprises a highly polished slate panel 2-ft. 0-in. wide mounted on an angle-iron framework with an extended metal-work back and equipped with: (*a*) one set of remote indicating and controlling equipment for the switchgear, including a 6-in.-dial ammeter with an ammeter-switch, a 6-in.-dial voltmeter, an emergency push-switch with hand-reset, a triple-pole inverse-time-limit over-current and earth-leakage relay, a double-pole over-current time-limit-fuse box with spares, and two indicating lamps (for on and off), one red and one green; and (*b*) one set of load regulating and controlling equipment, including a load-control beam-type relay with a plug-type selection-board, an under-voltage relay, repeater relay, an auxiliary-contact relay, a pump contactor-switch, a hand-to-automatic change-over switch, a service-selection switch, two contactor-type load-controlling relays, one for raise load and one for lower load, and a pump change-over switch.

A time-switch mounted on a bracket on one of the danels controls the supply to the whole plant.

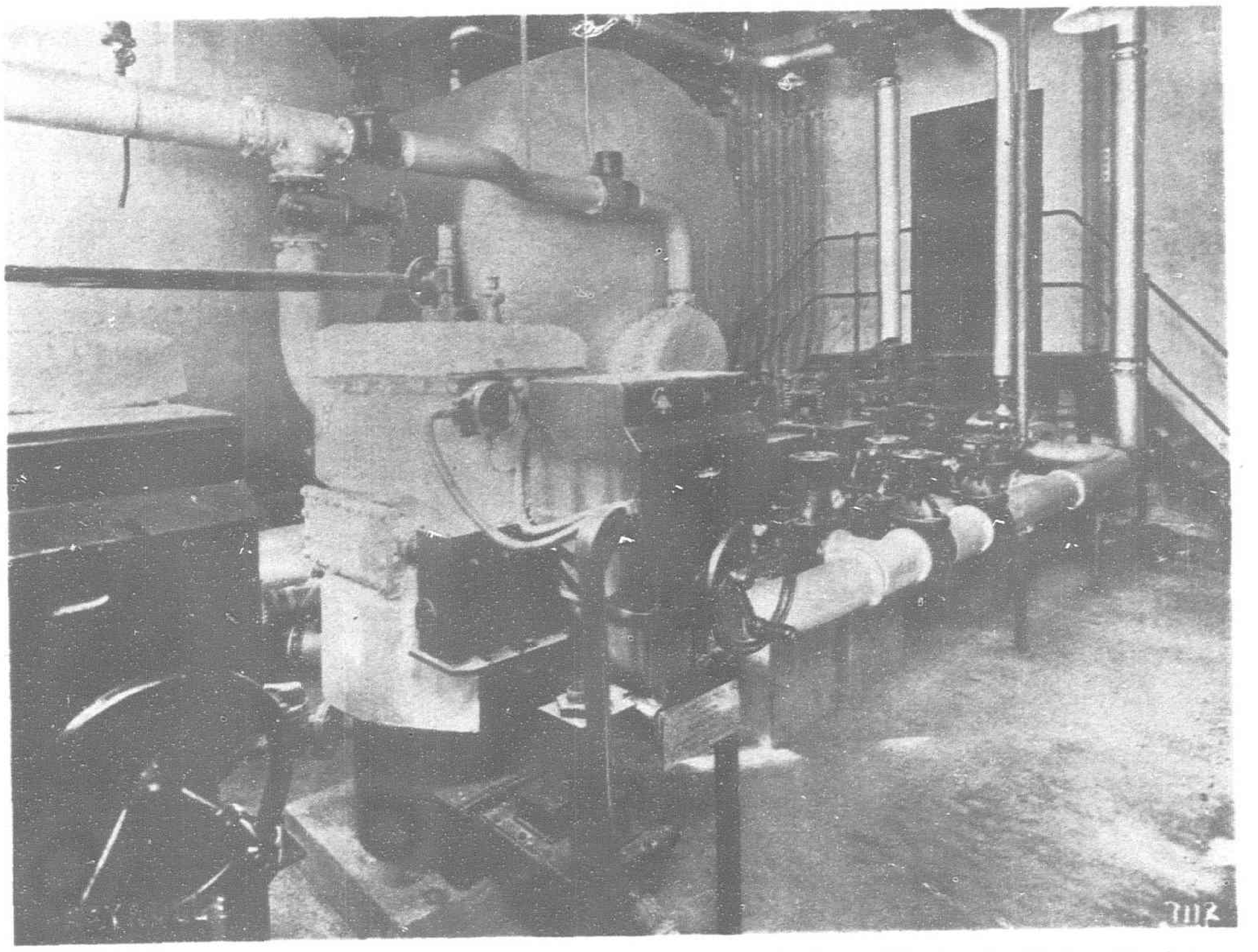


Fig. 5.—Close-up view of one of the 200-kw. 400-volt, 3-phase Electrode Water-Heaters

---

German Society Honors Elihu Thomson

On the occasion of his 82nd birthday, March 29, Dr. Elihu Thomson, holder of more than 700 patents in the United States and father of alternating-current distribution, who is generally considered America's greatest living scientist and inventor, was awarded the medal of honor of the Verein Deutscher Ingenieure, the outstanding award of the German engineering profession. Founded in 1856, the Verein, with a membership of more than 30,000, is the oldest and largest of engineering societies in the world. Its medal of honor has previously been conferred on but five non-Germans, only one of whom was an American—the late Dr. Calvin W. Rice. "Professor" Thomson, as he is most frequently called in his profession, is the first American to be awarded any German honorary medal or degree since the organization of the new government.

Presentation of the medal was made in Boston by Herr Von Tippelskirch, German Consul-General in that city, on the occasion of a meeting of the board of directors of the General Electric Company, of which Dr. Thomson was one of the founders. On the same day, in Berlin, more than a score of leaders in German science, industry, engineering, and statecraft gathered to do honor to the recipient of the medal. The notables present included U.S. Ambassador William E. Dodd, Ernst F. S. Hanfstaengel, foreign press chief of the Nazi party, and President Dr. Hermann Buecher of the Allgemeine Elektricitats Gesellschaft—who were addressed by President H. Schult of the Verein, who said: "We German engineers who, with our leader, believe that this world can only be freed from the great troubles of the world crisis by honorable, peaceful and fruitful work, honor Elihu Thomson, the inventor and research scientist. He is the great co-operator. As a visible sign of our honor, the German Consul-General Tippelskirch presents to-day to Professor Thomson in Boston the V.D.I. medal of honor."

The citation with the medal read as follows: "On Elihu Thomson, the great pioneer in the realm of engineering, the inventor and research scientist, the promotor of co-operation among engineers, there is conferred, on the anniversary of his 82nd birthday, the V.D.I. medal of honor."

The medal was accepted on behalf of Professor Thomson, whose health confined him to his home in Swampscott, Mass., by E. W. Rice, Jr. who is an old colleague of the recipient, is a former president of General Electric, and is now the honorary chairman of its board of directors.

Professor Thomson, besides being one of the founders of the General Electric Company of New York, is known among scientists all over the world for his research and inventions in the electrical field. In addition to being the father of alternating-current distribution and the grantee of more than 700 U.S. patents, he was a pioneer in arc lighting and wireless telegraphy development.

He has received so many honors and awards for his achievements that it is difficult to list them all. He is the only scientist in the world possessing all three of the following outstanding awards of English scientific and engineering institutions: the Faraday medal, the Kelvin gold medal, and the Hughes medal of the Royal Society. Other honors include the Franklin medal, the John Scott medal, the John Fritz medal, the Paris Exposition Grand Prix, the Rumford medal, the Elliott Cresson medal, and the first Edison medal of the A.I.E.E. He is a Chevalier and Officer of the French Legion of Honor and an honorary member of the Royal Institute of Great Britain.

"The Verein," stated Herr Von Tippelskirch in making the presentation, "was founded at a small place in the Harz mountains called Alexisbad by 28 enthusiastic men, none of whom was more than 30 years old. On the occasion of the 75th anniversary of the society, a monument was erected at Alexisbad which shows on a base of limestone the bronze figure of a youthful man, commemorating the founders. Simultaneously a medal of honor was created whose purpose it is to give due recognition to outstanding merits for the promotion of co-operation among engineers. The medal bears the youthful figure of the monument at Alexisbad."

Because of the fact that Germany is to-day in need of gold to support its currency, the medal is of bronze but is embedded in an especially designed case encrusted with amber, a material which is referred to in Germany as "German gold."

Some Chlorination Problems in Water Purification in Malaya*

Read at a Meeting of the Engineering Association of Malaya, Perak Section, at Ipoh on August 12, 1934

By W. W. DAVIDSON, M.C., M.A. (Cantab.), A.M.I.C.E., A.M.I.Mech.E.

In this paper it is proposed to mention some problems that have come to notice in connection with chlorination in a number of water supplies.

It is not proposed to deal with any of the matters of design and construction that arise in the provision of water supplies, but as a preliminary to the notes on chlorination itself a few notes on the reasons for purification of water will first be given.

Water Purification

Water purification comprises the removal of :—

(*a*) Inorganic matter which, generally speaking, affects the appearance and taste of the water.

(*b*) Organic matter derived from animal and vegetable forms of life.

DISPOSAL OF INORGANIC MATTER.—The removal of this, typical of which are sand and clay of various degrees of fineness, is a comparatively simple matter and is effected by sedimentation and straining, the effort required to get a water of satisfactory appearance being inversely proportional to the fineness of the individual particles of matter.

Whether such matter has been satisfactorily removed is a matter that can be judged by eye so there is no great difficulty about it.

Malayan waters are soft and removal of hardness due to the presence of lime has not to be practised.

DISPOSAL OF ORGANIC MATTER.—The living organisms or the matter derived therefrom which it is desirable to exclude from water delivered for human consumption range from animals of such size that straining is sufficient to exclude them to organisms of microscopic and possibly also of under microscopic size. That which can be seen is easy enough to deal with ; microscopic matter is more difficult.

RAW WATERS IN MALAYA.—The majority of our Malayan Water Supplies are from streams flowing from jungle covered granite hills the catchment areas on which are specially reserved and as near as can be entirely free from human habitation. There is of course various wild life but such is the activity of small life that it would seem unlikely as a general rule that any waste matter from such wild life could come down with any of the streams.

Bacteria may so far as they are of interest in regard to water purification be divided into :—

(*a*) Non-pathogenic—which are not known to cause disease.

(*b*) Pathogenic—which cause various diseases.

Those pathogenic bacteria which concern water supplies are of human or animal intestinal origin. Where existing they probably form a very small proportion of the total bacterial population of excreta, the greater part of such population comprising bacteria which in themselves are non-pathogenic.

The presence of non-pathogenic bacteria of types known to be of intestinal origin, however, is taken to indicate the possibility that the water may have been objectionably polluted and that pathogenic bacteria may also be present.

Dr. Daniels formerly Director of the I.M.R., F.M.S., in 1904, however, pointed out that conditions in the catchments are such as to be specially favorable to the growth of various micro organisms and that the water from jungle streams even where no major contamination is possible abounds with organisms of microscopic size and stated that none of such waters which he examined could be considered satisfactory bacteriologically. He stated that it was difficult to exclude the possibity that bacteria closely allied to intestinal bacteria might cause such disease, amongst persons who drank the water raw.

Whether the bacteria found in such raw waters are liable to cause disease is a mater that must be left to those in charge of Public Health and it does not particularly concern the Engineer whether their theories are valid or not. Suffice it that where Health Authorities consider there are grounds for suspecting the bacterial contents of a water the concern of the Engineer is to try to eliminate such bacteria.

Certain standards for water for human consumption chemical and bacteriological, have been laid down by the Health Department, F.M.S.; the attainment of these standards has been shown to be possible, and where purification is practised it is the part of the Engineer to try to bring his water to the standards required so far as equipment will allow.

CO-OPERATION OF EFFORT REQUIRED.—The organisms—bacteria—the presence of which in water is repugnant to Health Department ideas are microscopic and it is not possible for the Engineer by just looking at the water concerned to see whether there are any more or none present, or whether those present are harmless or suspected characters.

Moreover even under the high power microscopes the various species are not so readily distinguishable from one another as are say a cat and a dog in ordinary life ; the only way in which it can be determined what species are present is by the chemical substances which are formed by them under certain conditions.

It is obvious that the study of such organisms must be a whole time job and that no Engineer can hope to be in a position to do such work. He must depend on the Bacteriologist who has made it his life work to do the examinations for such bacteria.

The lot of the Bacteriologist himself in his work is no straightforward one. In Europe bacteria have been extensively studied yet even there, final decisions have by no means been reached. In this country where conditions are different and are moreover extremely favourable to such organisms, there must be many species as yet unstudied and unknown ; research has been limited and there must be much room for investigation.

Nor can the Engineer himself be a Chemist—which is another whole time occupation. We see, therefore, that the co-operation of the Bacteriologist, the Chemist and the Engineer are necessary to deal with the Purification of a Water if this is to be studied and controlled.

Of the three concerned the Engineer is the one closest connected with any particular water supply ; he controls the operations of his own particular installation and is in a position to compare it with others, so that providing he can interpret the results of the examinations by the Bacteriologist and the Chemist he is the person most favorably situated as regards improving the processes of purification.

CHEMICAL STANDARDS.—Certain standards have been laid down to be reached by water on chemical analysis. It is not necessary to detail or explain them, even if one could. Suffice it to say that the majority of waters in this country even before treatment attain the chemical standard required for water as supplied to the consumer.

Authorities consider, however, that the chemical constitution of a water is not a final indication of its suitability for consumption and that the Bacteriological test is the more important. Nevertheless the chemical analysis is of great importance as showing the constitution of the water and indicating how the problems of bacteriological purification can best be approached.

BACTERIOLOGICAL STANDARDS.—The standards laid down have two main requirements :—(*a*) that less than a certain number of Bacteria should be present per unit volume and (*b*) that certain types of bacteria should not be distinguishable in a certain volume of water. How the Bacteriologist does it does not concern the Engineer but he does reckon up :

(*a*) the number of bacterial colonies per cubic centimetre which is in this country required to be under 100.

(*b*) whether or not certain organisms may be presumed to be present in various volumes. If present the usual notation is a + ; if absent a 0.

Quarterly Journal of the Engineering Association of Malaya.

As a sample of the notation which is used in showing the results of a bacteriological examination a specimen is here given which would represent a water of the bacteriological standard adopted by the Health Department for supply to consumers in this country :—

C. C. 100	C. C. 25	C. C. 10	C. C. 5	C. C. 1	C. C. 0.1	Number of Colonies of bacteria per c.c.
+	0	0	0	0	—	99

In this sample the + indicates that the presence of suspicious bacteria was detected in a 100 c.c. sample of the water ; the noughts that in smaller samples of 25 c.c. etc., such presence was not detected. The "99" indicates that on a standard method of examination 99 colonies of bacteria were found in 1 c.c. of water.

In the case of a sterile water the form would be :—

C. C. 100	C. C. 25	C. C. 10	C. C. 5	C. C. 1	C. C. 0.1	Number of Colonies of Bacteria per c.c.
0	0	0	0	—	0	0

Such results as that last indicated have been achieved in various cases in this country by purification methods and as it is what the Health Department requires such result must be aimed at in purification systems.

Purification Methods

These divide naturally into three heads :—

(1) Storage. (including sedimentation)
(2) Filtration (*a*) natural ; slow
(*b*) assisted by chemicals ; rapid
(3) Chemical methods.

Storage.—Storage proper as a means of purification may be presumed to act by starvation of the bacteria. It has not been used in Malaya the general form of our supplies not being favorable. It is doubtful if this method would meet with much success.

Sedimentation is practised to some extent as a preliminary to filtration.

Filtration.—Both natural and assisted are practised. They act by straining out the bacteria.

Chemical Methods.—"Sterilisation" is the term generally applied to purification by chemical methods. Methods are various, in all the aim is to poison the harmful bacteria and spare the harmless ones though how the poison distinguishes between the two is a problem. In such methods the dead bodies of the bacteria must remain in the water unless subsequent filtration is practised.

The only chemical methods used in Malaya so far as is known to the writer is chlorination.

Chlorination

The value of chlorine for the sterilisation of water has been known for a considerable time but its use has only become common since liquid chlorine became readily available commercially.

Prior to 1914 chlorination was utilized in a few instances only such as in epidemics of water-borne disease. The chlorine so used was derived mostly from bleaching powder, a substance which gives off only a certain portion of its weight in chlorine the residue being a lime sludge. The amount of chlorine in bleaching powder is liable to fall owing to deterioration and altogether though useful enough in its way it is awkward to use in any quantity.

Such chlorination was successfully practised during the European War, but towards the end of this pure chlorine was also used.

Chlorine of great purity is available now in liquid form. It is in handy form, is cheap, does not vary, is cleanly to use ; as it is drawn off for use it turns to its gaseous state and the gas is very soluble and fairly easy to introduce into water.

Its only disadvantages are that it is highly poisonous (so that an escape of the gas is not a thing to be desired) and that it readily corrodes the commoner metals.

It is not intended in this paper to give an account of the apparatus used for introducing chlorine from the chlorine cylinder to the water ; suffice it to say that apparatus is available by means of which chlorine can be delivered in regular amounts as desired.

Chlorine Dose.—Having the chlorine and the apparatus for introducing it into water the next question is how much should be used or what should the chlorine dose be.

The dose is specified by the number of parts of chlorine that are used per 1,000,000 parts of water, both by weight. The dose must be enough to kill all harmful bacteria but must not be so great as to cause taste or smell troubles. The dose for any water depends on :

(*a*) Species of bacteria, their numbers and their resistive powers.
(*b*) The physical and chemical conditions of the water.
(*c*) How long the chlorine remains in contact with the bacteria.

and in each case must be worked out experimentally, bacteriological examinations being made to determine if particular doses and periods of contact have been effective. One authority states that in England with water which does not need any of the chlorine for oxidising organic matter contained in it, a dose 1/10 the part per million will kill bacteria of typhoid and dysentery groups in a few minutes. Another authority states that some waters may require as one part per million with five hours contact.

With an ordinary water not all the chlorine which is put into it is available for poisoning bacteria, some goes to oxidise organic matter which the water contains and chlorine being a very active element chemically it is probable that such oxidation as takes place does so in a time very much shorter than that required to poison the bacteria ; these have to be dealt with by such chlorine as is "left over." This chlorine is termed "residual" or "free" chlorine.

One of the details usually given in the chemical analysis of a Water is what is termed the "Oxygen Absorption" measured under certain standard conditions. This is a measure of the oxidisable organic matter contained in the water and is of considerable importance as on it depends to a great extent how much residual chlorine will be available. "Oxygen Demand" is a convenient term to use.

Dose for Conditions in Malaya

Experience elsewhere is not necessarily a guide as to the chlorine dose that will be required in Malaya owing to possible difference in respect to :—

(1) Resistance of bacteria to chlorine.
(2) Differences in the water.
(3) Meteorological differences—light and temperature.
(4) Time of contact possible.

Resistance of Bacteria.—The writer knows of no data about this : but it does seem possible that bacteria may be more difficult to kill here than in England, or on the other hand may be easier to kill. It seems a matter that would be worth investigation.

Differences in the Water—Oxygen Demand.—The meaning of the term "Oxygen Demand" has been explained. In a chemical analysis it is given as so many parts of Oxygen per 100,000 parts of water (by weight). For a number of Perak supplies the figure for the raw water, i.e., before filtration, averages .16 parts per 100,000, a figure considerably higher than for the general run of raw waters in England.

Chlorine can take the place of oxygen in meeting such demand but for every 16 parts of oxygen that would be required for a particular effect 70 parts of chlorine would be required. Assuming then that Chlorine could completely oxidise the average raw water of .16 Oxygen Demand, the quantity of Chlorine required would be .7 parts per 100,000, or expressed in parts per million (abbreviated to "p.p.m."), as is usual for the chlorine dose, 7.0 p.p.m. of chlorine. Actually considerably smaller doses of chlorine are effective in sterilisation so that it seems clear that not all the oxidisable matter is acted on by the chlorine. But without doubt some is.

The Oxygen Demand of a water can be very considerably reduced by filtration as is shown in table A below ; the figures in which are taken from analyses by the Chief Chemist, Institute of Medical Research, Kuala Lumpur.

In this case much of the chlorine has gone to oxidise organic matter leaving only a small proportion of residual chlorine for poisoning bacteria.

Even the few figures given in Table B above show that considerable differences in the Oxygen Demand of the raw and treated waters exist. To emphasise this it may be mentioned that the Oxygen Demand of the raw water of Supply A varied between .129 and .290. In another supply the oxygen demand in the water has varied between .053 and .346 and this water not being filtered prior to chlorination it would be necessary to apply varying doses of chlorine to the water to leave the same residual chlorine in the different cases. It is evident, therefore, that if water of varying Oxygen Demand is to be chlorinated successfully it will be necessary to vary the chlorine dose to suit the condition of the water ; to do this there is an opening for some simple and rapid apparatus for determining the Oxygen Demand at the works so that the Chlorine dose can be regulated to suit.

IMPORTANCE OF FILTRATION.—As the Oxygen Demand of most raw waters varies greatly from time to time but can be much reduced, and to a more uniform figure, by filtration, it is desirable that as effective filtration as possible should be practised in any water supply even where chlorination is to be carried out. It would seem preferable to use Chlorine in moderate dose after filtration to put the final touch to the purification process rather than that it should be entirely relied upon to take the place of filtration.

Meteorological Conditions

TEMPERATURE.—In Malaya there is little variation in the temperature of water as between night and day, or from day to day so that adjustments of the chlorine dose are not required for temperature.

As regards temperature effects it may be of interest to note that in an investigation on chlorination in Swimming Baths in England by Messrs. Braxton-Hicks, Pulverstaft & Chopping the authors state that in hot weather it was not possible to keep the chlorine concentration in the baths above 0.3 p.p.m. owing to the rapid evaporation.

LIGHT.—The writer has found that in this country the effect of light on chlorine in water is of the utmost importance. In fact it appears that the action of light can cause almost instantaneous disappearance of chlorine as such from water unless special measures can be taken to prevent this.

It is well known that Chlorine and Hydrogen have a great tendency to combine. Quoting from " Chemistry for Organised Schools of Science " by Parrish :

> " If chlorine and hydrogen are mixed and exposed to diffused daylight, they unite slowly ; if they are exposed to bright sunlight, or......they unite with an explosion. In the dark, no union takes place."

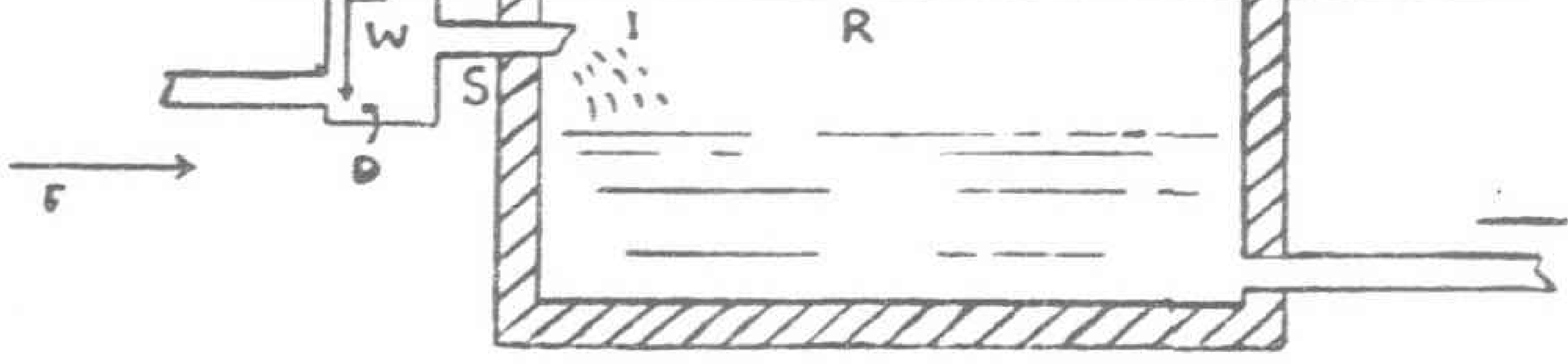
In " Examination of Waters and Water Supplies " by Thresh Beale and Suckling it is stated (p.610) that " loss of chlorine is very rapid when water is exposed to the air, and particularly to sunshine, and conversely, it is often very slow when confined in water mains."

In view of the statement quoted above and the results of certain bacteriological examinations the writer was led to enquire into the extent to which chlorine was affected by light in Malaya and decided to try the estimation of the residual chlorine in certain chlorinated supplies by night and by day for comparison. Some difference was anticipated by nothing like what was found.

Residual Chlorine Tests

SUPPLY A.—The first supply tested was one in which slow sand filtration is practised but has to be done much in excess of normal rate, and in which a chlorine dose of 0.5 p.p.m. was being given ; chlorination is affected in this supply in a well immediately before the water passes into the Service Reservoir which is an open one, the general arrangement being as indicated in Diagram 1 below.

DIAGRAM 1.



F............ Filtered water main.
W............ Chlorinating well.
C............ Chlorinator.
D............ Chlorine Diffuser.
R............ Service Reservoir.
I............ Inlet delivering chlorinated water to reservoir.

TABLE A.

Oxygen Absorption........parts per 100,000

	Mechanical Filtration		Slow Sand Filtration	
	Supply A.	Supply B.	Supply C.	Supply D.
Raw water	.202	.189	.157	.095
Filtered water	.031	.034	.091	.070
Filtered and chlorinated water	.630	.031	.090	.054

The figures are averages of a year's samples.

The figures in Table A show a considerable reduction in Oxygen Demand by Mechanical Filtration whilst with slow sand filtration there is also a reduction but to a lesser extent. A further fact appears from the figures namely that with mechanical filtration the decrease in the Oxygen Demand on chlorination subsequent to filtration is very small pointing to the likelihood that with such filtration little chlorine is used in oxidising organic matter. With slow sand filtration however there is much more of a fall in the oxygen demand, pointing to the chlorine having been largely used in oxidising matter.

This point is emphasised by table B given below and taken from some recent analyses of a water supply :—

TABLE B.

Sample No	OXYGEN DEMAND PARTS PER 100,000.			Fall in Oxygen demand by Chlorinated P.P. 100,000	EQUIVALENT CHLORINE ABSORPTION		Working Chlorine dose used P.P.M.
	Raw water	Filtered water	Filtered and Chlorinated water		P.P. 100,000	P.P. Million	
1	.081	.062	.053	.009	.039	.39	.6
2	.068	.045	.030	.015	.065	.65	.6
3	.076	.051	.040	.011	.048	.48	.6
4	.077	.071	.057	.014	.061	.61	.7
5	.109	.092	.086	.006	.026	.26	.9
6	.065	.051	.035	.016	.070	.70	.95

Tests for Residual chlorine made between 5 and 7 a.m. gave the following figures :

Residual Chlorine.

Mouth of Inlet pipe I .. .. .. 0.3 —0.4 p.p.m.
Reservoir near Inlet .. .. .. 0.05—0.07 ,,
Reservoir near Outlet .. .. .. 0.05—0.06 ,,

Some residual chlorine was found in every sample taken.

At 3 p.m. a further series of tests was made. The day was a dull one with a slight drizzle at times. The chlorine dose had meanwhile been increased to 0.6 p.p.m. and the following results were obtained.

Mouth of Inlet pipe I .. .. 0.5 p.p.m.
Reservoir near Inlet 6 samples .. .. .. no trace.
Reservoir near Outlet 2 samples .. .. .. no trace.

Having been unable to find any residual chlorine anywhere inside the reservoir a final sample was taken at the mouth of the Inlet pipe and showed 0.5 p.p.m. here. Later tests confirmed that in the daytime residual chlorine was usually absent from the water in the reservoir.

An important point is that in this case the Inlet pipe was delivering its water near the top level of the reservoir and the water level inside being well down from top level the water fell several feet to the then water level. In this short distance all the residual chlorine disappeared !

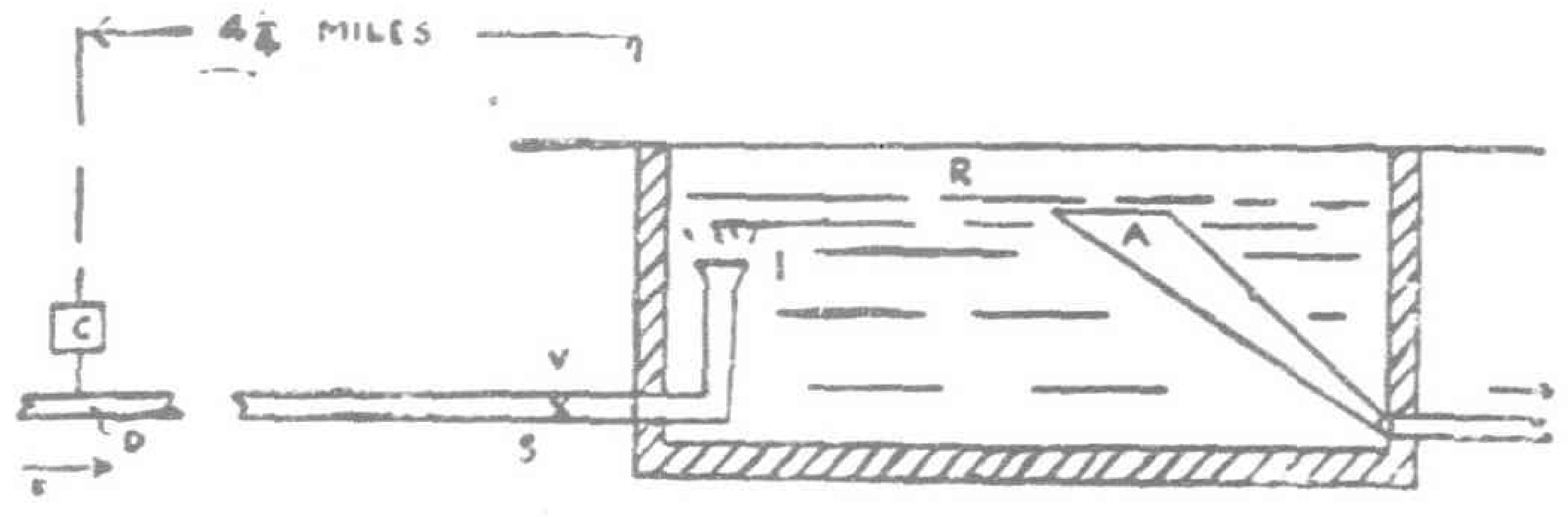
Subsequently the inlet pipe was extended to deliver near the floor of the reservoir ; this appears to have had a beneficial effect in reducing loss of residual chlorine as evidenced by the figures given below, which were taken at 11 a.m. on a fairly bright day the dose being 1.0 p.p.m.

Inlet pipe .. .. .. 0. 6 p.p.m. Residual Chlorine.
In Reservoir near inlet bottom 0. 4 ,, ,,
,, ,, top .. 0.35 ,, ,,
,, near outlet bottom 0.07 ,, ,,
,, ,, top .. 0.06 ,, ,,

The supply next tried is one where chlorination is affected immediately the filtered water leaves the filters, which are mechanical, the chlorine being injected into the main immediately after filtration; the time of transit from chlorinator to service reservoir varies with the rate of supply and on this occasion was about two hours. In this supply as indicated on Diagram 2 the inlet main comes into the reservoir near the floor and delivers its water upwards through a bell mouth at about half way up.

SUPPLY B.

DIAGRAM 2.



F	Filtered water main.
C	Chlorinator.
D	Point of application of chlorine.
R	Service Reservoir.
I	Inlet delivering chlorinated water to reservoir.
A	Floating arm draw-off.
S	Sampling cock on Inlet main.

In a preliminary test on this supply in the forenoon the dose being 0.4 p.p.m. it was found that the water was reaching the Reservoir Inlet with .1 to .15 p.p.m. residual chlorine but that hardly a trace could be got anywhere in the reservoir itself.

A further test was made some days later. After the reservoir had been cleaned it was decided to fill it after dark with water at 1.0 p.p.m. and let it stand all night. This was done and at 4.45 a.m. there was no doubt on tasting that the water was chlorinated. With a full moon and clear sky the following results were obtained up to 7 a.m.:—

Down throat of inlet pipe	0.6—1.0 p.p.m.
In reservoir in various places, at bottom and surface	0.4—0.6 ,,

(Chlorine was found wherever tested for).

At 10.45 a.m. tests were carried out again; nowhere within the reservoir could any trace be found except down at the bottom of the throat of the inlet pipe where there seemed to be a small pocket of water which showed 0.25 to 0.06 parts of residual chlorine.

As a check, samples of the chlorinated water which had been standing in the main since shutting off the flow to the reservoir were drawn off from a sampling cock just before the inlet valve. This water had then been standing in the main some six hours besides the two hours it had taken to come down the main. On being tested the residual chlorine in several samples was in the region of 1.0 p.p.m.

So that while the water exposed to light in the reservoir had been entirely dechlorinated in a short time that which was confined in the darkness of the pipe retained all its chlorine some eight hours.

TESTS IN OFFICE.—Further samples of the chlorinated water in the inlet main were then drawn and, covered up to prevent action by light, were taken to the office of the writer and there experimented with to see how long the residual chlorine persisted when exposed to light and when shielded from it. The results of the experiment are given in an Appendix; a graph is given showing how the residual chlorine fell under different conditions.

RESIDUAL CHLORINE IN LIGHT AND DARKNESS.—The fact that the extension of the inlet pipe of Supply D so as to deliver the water at the bottom of the reservoir effected an improvement in the residual chlorine held in the water shows how the smallest detail may be of importance. It appears that the presence of a "blanket" of upper layers of water prevented the action of light on the lower layers of water thereafter to some extent. It would seem that the best way to ensure the retention of residual chlorine in the water for the necessary period of contact would be to arrange that the chlorinated water remain under cover for the time necessary to effect sterilisation. The lay-out of some supplies may enable at any rate part of this time to be spent in the mains on the way to the service reservoir. For the remaining period necessary, or in supplies where chlorinated water does not pass through a main at all before reaching the service reservoir covered contact chambers would appear to be necessary.

One could in this country superchlorinate in a covered chamber to make sure of sterilisation and then dechlorinate very effectively by having an open service reservoir of such size that no water would get through it without having been exposed to daylight.

A further point of interest arises, viz., that in a supply where part of the necessary period of contact has to be spent in the open it seems possible that the degree of sterilisation may vary with the time of day. This seems to be the case in the supply referred to as Supply D for a series of examinations of samples taken at 6 a.m. and 6 p.m. with a chlorine dose of .7 p.p.m. showed good results whereas there has been a falling off in later examinations taken at 2 p.m. though the dose had been increased to .9 p.p.m. Experiments with samples taken at various hours during the day and night should be of much interest.

SAMPLES.—Another point of interest that arises is the question whether the bacteriological results of samples always truly represent the result in the water that was sampled.

Consider the case of a sample of water from the inlet pipe in the case of Supply D with .5 p.p.m. residual chlorine in it. The sample is run straight into a bottle which is stoppered and put into a dark box in which it remains till taken out for examination at the laboratory. There is no doubt of chlorine contact in the bottle all this time; the water delivered into the reservoir on the other hand may have at once lost its chlorine and would in such case have no period of contact. In such a case the outlet sample would appear to be the more reliable indication of the efficacy of treatment.

Thresh, Beale & Suckling in "The Examinations of Water and Water Supplies," p. 691, state:—"It must be remembered that the bactericidal action of the free chlorine present in the water will continue during transit of the sample to the laboratory."

Time of Contact

Having residual chlorine in a water to be sterilised it does not immediately poison all the bacteria therein. It requires some time to do so varying with the resistance of the bacteria under the water conditions, and the strength of the residual chlorine. The more residual chlorine available the shorter the time of contact and *vice versa*.

For Britain, Thresh, Beale & Suckling state the dose should be at least half to one hour; another authority states that anything from 20 minutes up to several hours may have to be allowed.

As regards this country reliable information would seem to be lacking; a certain amount of information is available as the result of examinations of water from supplies in which the chlorinated water passes down a main for some time after chlorination before reaching the light of day with satisfactory results as regards the inlet samples but as regards these samples the writer thinks that there is doubt if the samples truly represent the bulk of the water. The outlet samples if taken as the criterion are not so satisfactory.

There is need for research into the question of time of contact required in this country. Such research would be best carried out in a laboratory, and would need to be on an extensive scale to get satisfactory conclusions.

Action of Chlorine on Bacteria

A point of interest with regard to the action of chlorine on bacteria arises in connection with the rapid loss of chlorine in daylight in this country.

The chemical action which occurs in a solution of chlorine in water in the presence of sunlight results in the formation of hydrochlorine acid and of oxygen. This oxygen in the nascent state was till recently thought to be the active agent in killing the bacteria. Thresh, Beale and Suckling however state (p. 608): "It was at one time believed that the mode of action of chlorine was an oxidising one, nascent oxygen being the real bactericidal agent in the process of chlorination. This view is, however, no longer tenable and it is more likely that the chlorine is directly toxic to bacteria......"

This latter opinion would appear to be confirmed by the results obtained where daylight affects chlorinated water supplies. In the cases where chlorine has disappeared almost instantaneously it would appear not unreasonable to expect that there would be a relatively great release of nascent oxygen and if the old theory

(Continued on page 269).

The Shanwupoa Tin Field, Kianghua, Hunan*

(SUMMARY)

By Y. J. LIAO and Y. T. HSU

The Shanwupoa Tin Field is located nearly in the extreme south of Kianghuahsien about 120 *li* from the Kianghua City, with Holukou as its center where the Official Mining Board is situated. There are two ways of transportation: one is to Changsha and the other to Canton. By the former way freight is usually carried on shoulders for 120 *li* to Kianghua City, taking about two days. From Kianghua City a small river called Taochiang flows to Lingling for a distance of 440 *li*. During high water seasons junks of 6 to 7 tons capacity can pass freely to Lingling in three days while during low water seasons six or seven days are usually required. At Lingling larger junks can be used for transporting to Hengchow along Hsiangchiang. It usually takes from 15 to 20 days from the mine to Changsha. By the other way to Canton, man power is required for carrying for 25 *li* to Peisha, Kwangsi, where automobile cars are available to Papu taking about one day. At Papu junks of 10 to 20 tons capacity can pass down along Hochiang to Wuchow in about four days. From Wuchow to Canton large steam boats are available throughout the whole year.

Topography

Shanwupoa is a mountainous region in the Nanling Range. A high mountain called Tsangwuling forms the water-shed between Kwangsi and Hunan territories, having an elevation of more than 1,000 meters above sea level. It is, for the most part, composed of granite, but its northwestern foothills are of limestone. In the limestone there is a series of joints present which arrange themselves in groups, mostly assuming the northeast and northwest directions. Along the joints erosion has played an important rôle, thus producing many cone-shaped hills or rock remnants which give a peculiar feature to the topography of the district. In the limestone many caves have been formed and through some of them rivers or streams flow underneath. The contact zone of the granite with the limestone, is easily attacked by erosion and a valley has been developed in which streams are flowing.

Rocks

Limestone.—Limestone is widely distributed in the area surveyed, forming a number of cone-shaped hills. Lithologically it may be divided into the siliceous, the dolomitic, and the ordinary limestones. Their total thickness is about 700 meters. Along its contact with the granite marble is often found. Another kind of contact metamorphic rock is observed at Shankoukeng which shows a greenish or whitish gray color. It consists chiefly of actinolite and tremolite with a little muscovite, diopside, and calcite, and was formed from the dolomitic limestone by contact metamorphism. In the upper part of the limestone formation *Cyathophyllum cf. loczyi* French is found, showing that it is probably of Middle Devonian age.

Quartzite and Shale.—This series of quartzite and shale occurs in the northwestern part of the area surveyed near the Kwangsi borders. It lies comfortably upon the Devonian limestone just mentioned and probably still belongs to the Devonian. The quartzite is light gray in color and is very dense. Under the microscope it is seen that quartz is the essential constituent mineral with a little serpentine, dolomite, and a little iron oxide. The shale is mostly thin bedded, gray in color, and seriously weathered on the surface.

Granite.—Granite occurs in the southeastern part of the field as high mountains running in the general direction of NNE—SSW. It is usually light gray in color and sometimes has a porphyritic texture. The rock forming minerals are perthite (most abundant), albite, orthoclase, quartz, biotite, and a little magnetite and pyrite. Joints are well developed in the granite and may be divided into three systems. One is nearly horizontal and the other two are practically vertical, about at right angles to each other. Most of them run in the northeast and northwest directions. Owing to the different system of joints present, the granite has been dissected into blocks, thus producing huge pieces of rock lying on the mountain slopes. The granite has been at some places metamorphosed into greisen which has been weathered seriously to form a mixture of kaolin and quartz, varying from whitish brown to yellowish green in color. Regarding the age of intrusion, as the granite directly intrudes into the Devonian limestone, it is evident that it would be later than Devonian. Moreover, the granite body here belongs to the same batholith of the Nanling Range of which the age of intrusion is still uncertain. And in the vicinity of I-Chang the granite intrudes into the Permian limestone, but the Tertiary red sandstone has not been affected. Further, at some places in the Hunan-Kwangtung borders Jurrassic formations are reported to be intruded by the granite. From these facts it can be seen that the time of intrusion of the Nanling granite is probably about at the end of Cretaceous or the beginning of Tertiary.

Geological Structure

The geological structure of the district is in general an anticline with an inclined axis. Starting from the northeastern and extending to the southwestern corner, the strike of the strata changes gradually from N 25° W to N 20° E and the dip from N 65° E to N 70° W, thus forming an anticline, the axis of which is located about at Ouyangshan and Kuchuping, pitching to the north and striking N 10° W.

Ore Deposit

Occurrence.—The tin deposits of this district belong to the "Placer" type, the ore mineral cassiterite being mixed with clay and sand. According to the mode of occurrence these may be again divided into two types:—

(1) Those Occurring in the Valleys and Depressions.—These are the principal deposits which are now being mined. Their distribution is closely connected to the surrounding topography. The most favorable places for their occurrence are along or not far from the contact zone between the limestone and the granite, because here the rocks most easily attacked by weathering, forming low lands where the tin mineral cassiterite can be easily deposited and concentrated.

(2) Those Occurring in the Limestone Caves.—When the surface or underground waters flowed into the limestone caves, the soil and tin stones which they had carried were gradually deposited and concentrated to form workable deposits.

Mineralogy.—The only ore mineral is cassiterite or tin stone, an oxide of tin. It usually occurs as grains with sharp edges. Perfect crystals and large pieces are sometimes also present. The associating minerals are magnetite and hematite which occur without definite crystal form in the interstices of tin stone as can be seen from the examination of the large pieces. In the tailings obtained from washing and screening of the ore, these are abundantly found with quartz and a little amount of manganese and arsenic bearing minerals. Regarding the size of the tin stone it can be said that the farther it occurs from the granite, the finer it would be. Fine grains range from ½ to 2 or 3 mm in diameter, coarser ones about several cm, but large pieces weighing 10 to 100 pounds each have also been found. In the cave deposite the grains are still finer and more even, and no large pieces could be seen.

Quality of Raw and Washed Ores.—The amount of tin stone in the raw ores occurring along the hill sides varies from a few taels to several catties per picul, but in the cave ores usually from 5 to 20 catties or more. One sample of the washed concentrated ore gives the following analyses: Sn 74.14 per cent, As 0.024 per cent, Fe 1.17 per cent, and Mn 0.087 per cent.

---

*Geological Survey of Hunan, Bulletin 17.

Mining and Smelting

The tin deposits in this district was worked by the native people early in the Ming Dynasty. About in the Middle Years of Kwanghsu of Ching Dynasty there were seven companies organized. In 1912, the First Year of the Republic, most of the mining claims were taken over by the Hunan Provincial Government and the Official Mining Board of Kianghua was established. Later the private companies were closed one after another. Since 1928 the Official Mining Board has become the only operator of the district.

Mining is carried on in three different methods. One is the open pit method which is often used in flat areas where the placer ore lies very near to the ground surface and is rather high grade. The second is the underground method which is used in comparatively deep deposits. A vertical shaft is sunk, and after penetrating the covering soil to the ore, horizontal workings are opened for the extraction of the ore. The shaft is usually from 15 to 90 feet in depth. When underground water is met with mining has to be stopped due to lack of pumping machinery. The third may be called "the native hydraulic method" and is used where surface water supply is plenty. Trenches are opened along hillsides and water is led to flow through them to the working place where it enters a channel or sluice inclined at an angle of about 5°. The latter is about two feet wide and from 100 to several hundred feet long and is rifled with parallel strips of wood. Raw ore is continuously fed to it and is washed by the flowing water. The tin stone, being heavier, is collected below the rifles while the clay and gangue minerals are washed away. The channel or sluice is cleaned every 10 or 15 days and the concentrated ore is taken out.

The ores obtained from the above methods still contain impurities which are further removed by washing in wooden troughs and bamboo screens. The high grade concentrate thus obtained may reach 90 per cent of cassiterite.

In smelting for tin metal the process here used is more simple than in the other tin mines in Hunan where tin and arsenic occur together and therefore roasting and distillation are required before smelting in order to drive out the arsenic. Smelting is done in native shaft furnaces about 2 meters high and 0.65 meter in diameter. The tin concentrate is charged into the furnace in alternate layers with charcoal. In about one hour after firing, liquid metallic tin begins to drip down, collecting in an iron pan. Then it is poured into iron molds to form tin ingots, weighing 25 catties each. In a shift of 12 to 15 hours 700 catties of tin concentrates can be smelted, requiring the same weight of charcoal and producing about 500 catties of tin metal. The cost of smelting is about $5.60 per 100 catties or $95.20 per ton of metal produced.

The following table shows the annual production of tin metal of the Official Mining Board of Kianghua from 1926 to 1933.

1926	564 (piculs)	1930	626 (piculs)
1927	439 ,,	1931	788 ,,
1928	226 ,,	1932	836 ,,
1929	960 ,,	1933	887 ,,

Some Chlorination Problems in Water Purification in Malaya

(Continued from page 267)

were correct this should be extremely effective in killing the bacteria present. Results have not indicated that it is.

Change in Water in Reservoirs

In some cases where bacteriological examinations of water have been made of water at the inlets and the outlets of the reservoirs the latter water has shown less satisfactory results than the inlet water.

At one time the writer thought this represented a deterioration in the water in passing through the reservoir but he is now not so sure of it on account of doubt as to whether sample results of inlet water do not give an artificial result not truly representative of the bulk of the inlet water. On the other hand results from a reservoir where the incoming water is under good conditions as to chlorination and then enters into a covered reservoir indicate that deterioration may occur.

Conclusion

It is hoped that the preceding pages will have shown some of the problems that arise in the course of water sterilisation by use of chlorine in Malaya and the wide field there still is for research in the matter. In conclusion an engineer offers two non-engineering problems that puzzle him, for solution.

I. Is the wholesale poisoning of the bacteria in water desirable or will a school of thought one day decide that man is so depriving himself of bacteria which are essential to the processes of life ?

II. What becomes of the corpses of bacteria killed by sterilisation ? If they were of size visible to the naked eye a water full of corpses would not be popular. Seemingly "what the eye don't see, etc.," or perhaps it is a case of "lesser bugs eat lesser bugs " and so *ad infinitum*."

Automatic Telephones for Ceylon

(Continued from page 258)

Purchase of necessary humidifying plant at Maradana, and installing same	14,000
Replacing magneto private branch exchanges in the Maradana area for others suitable for automatic working	5,000
Providing and laying new junction cable (armored)between Central and Maradana Exchanges	45,000
(*d*) *Modernizing existing Rural Exchanges by installing automatic equipment and thus giving a 24 hour service* ..	30,000
(*e*) *Installing Rural Automatic Exchanges in various parts of the Island which are not at present servedwith telephone facilities*	263,000
It is proposed to install ten automatic exchanges together with their connected junctions and subscribers lines.	——
(*f*) *Providing additional subscribers circuits to existing and new exchanges*	875,000
This proposal may be subdivided into the following items :—	
Estimated cost of providing additional subscribers circuits to existing and new exchanges	500,000
Provision for new trunk or junction lines and necessary exchanges as may be approved..	250,000
Extensions to, or increasing the capacity of existing cables	125,000
(*g*) *Taking over Telephone Systems at present operated by private enterprises, and modernizing same*	160,000

The Boiler Plant Installed in the Nanking-Hsiakwan Electricity Works

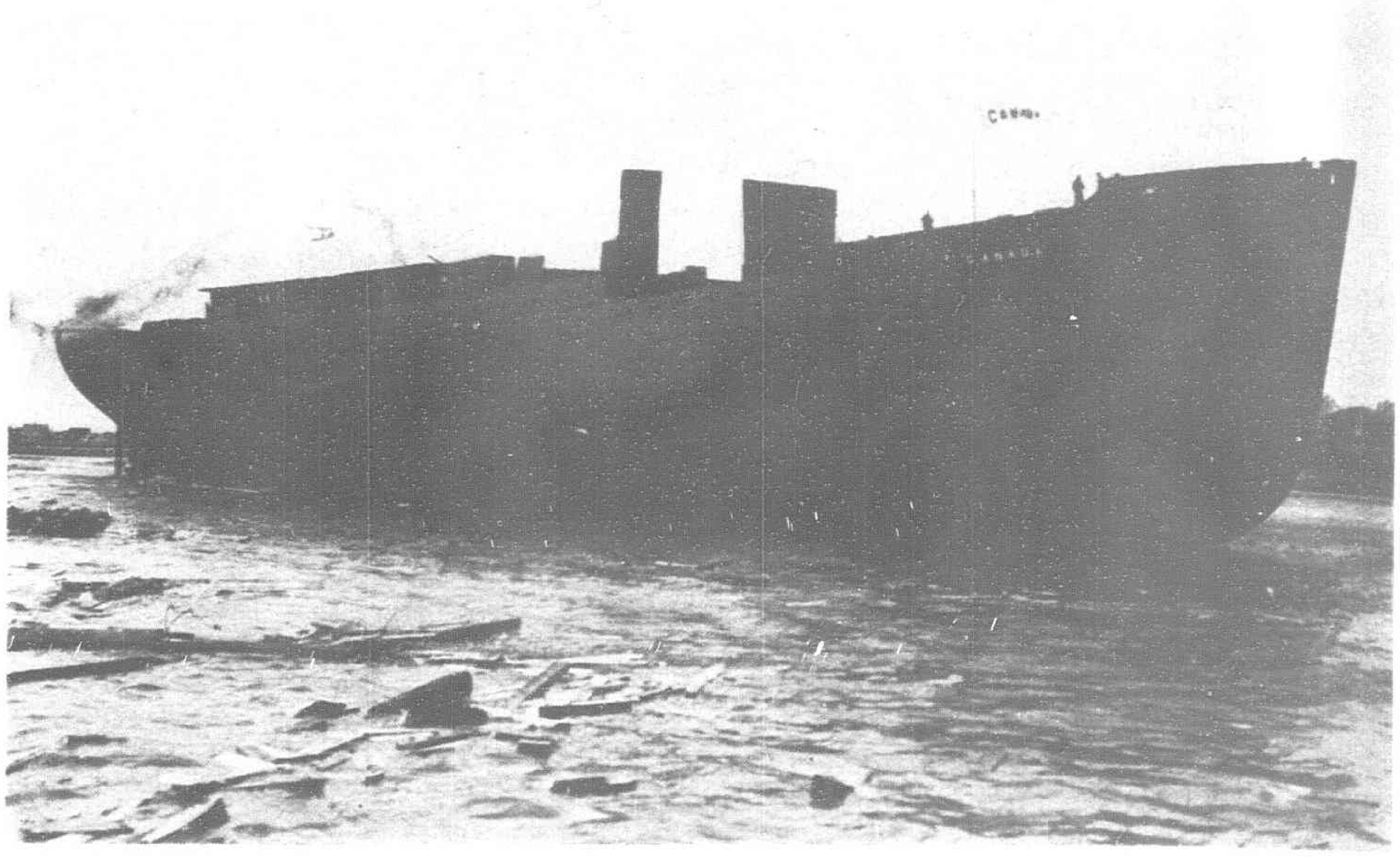
(Continued from page 254)

(2) Consumption :			
(*a*) Per hour	kgs.	29,160	34,920
(*b*) Per hour and per 1 sq. meter of heating surface	kgs.	41.7	49.9
Steam :		——	——
(1) Pressure (above atmospheric) ..	atm.	27.4	27.5
(2) Temperature of superheat.. ..	°C.	389	394
Waste Gases :			
(1) Temperature behind Economizer..	°C.	170	175
(2) Contents of carbonic acid	%	12.1	12.2
(3) Excess of air	—	1.53	1.51
Distribution of Heat :			
(1) Total efficiency	%	84.6	84.0
(2) Loss :		——	——
(*a*) Due to waste gases	%	8.7	8.8
(*b*) Due to unburnt substances in the slag, coal falling through the grate, and flue coke ..	%	5.4	6.0
(*c*) Due to conduction and radiation	%	1.3	1.2

The fact that a co-efficient of efficiency of 84.6 per cent was achieved for normal and of 84.0 per cent for maximum load proves the suitability of the type of plant and its excellent operation. It may be added that, in one of the other tests, when the plant was subjected to a load exceeding its maximum load by five per cent, operation could be continued for hours without the water in the steam space commencing to foam.

The working of the boilers from the time of erecting them until this day has not given rise to any modification of the view that the plant conforms to all the expectations entertained at the beginning.

New Ship for Service in Pacific is Launched from Nakskov Shipyard



The Motorship "Canada" at Scene of the Launching

On May 16 the motorship *Canada*, built to the order of Messrs. The East Asiatic Company, Ltd., Copenhagen, was successfully launched at Nakskov Skibsværft, Nakskov, Denmark.

The principal dimensions are:

Length b.p.	465-ft. 0-in.
Breadth mould	64-ft. 0-in.
Depth to Upper deck	40-ft. 0-in.
Carrying capacity	about 12,000 tons d.w.

The ship is built to British Lloyd's highest class and complies with the rules laid down by the London Convention of 1929 for passenger ships. The ship is built as a "Complete superstructure" ship with long bridge and forecastle with seven watertight bulkheads, all carried through to the upper-deck, and with double bottom in the whole length of the ship. She is fitted with five hatches, two masts and eight derrick posts; 17 derricks, eight of which can lift 3 tons, 8—5 tons and 1—30 tons; 16 electrical winches are fitted, eight of which can lift 3 tons, 6—5 tons and 2—7 tons, one electrical warping-winch on the poop and electrical windlass. All the deck auxiliaries are supplied by Messrs. Thomas B. Thrige, Odense, Denmark, which firm also supplies the electrically driven steering gear.

Further the ship is arranged with about 150,000 cb. ft. insulated cargo space, divided into 10 compartments, and equipped with refrigerating plant carried out to the latest principles for carrying fruit, etc. The refrigerating machinery is supplied by Messrs. Thomas Ths. Sabroe & Co. A/S, Aarhus, Denmark. The ship is built as a passenger-and cargo-motorship specially designed for The East Asiatic Company's Pacific route, and is equipped for 56 passengers.

The cabins and saloons will be somewhat larger and arranged and equipped even more comfortably than the m.s. *Amerika* and m.s. *Europa* previously built for this route. Each cabin is arranged with detached bed and adjoining bathroom, and the dining-saloon on the bridge deck, smoking-saloon and ladies'-saloon on the promenade deck are all fitted out in a high class modern style. The smoking-saloon will be fitted with a bar, and on the bridge deck there will be a separate dining-saloon for children adjoining to the dining-saloon.

The propelling machinery consists of one B. & W. double-acting, two-stroke diesel engine of ca. 8,400 i.h.p., which will give the loaded ship a speed of ca. 16 knots. The ship is just as the m.s. *Amerika* and m.s. *Europa* fitted with two funnels.

After the launching the ship was moored at the builders' fitting-out quay to have her engine installed and the equipment completed. Delivery will take place at the end of July.

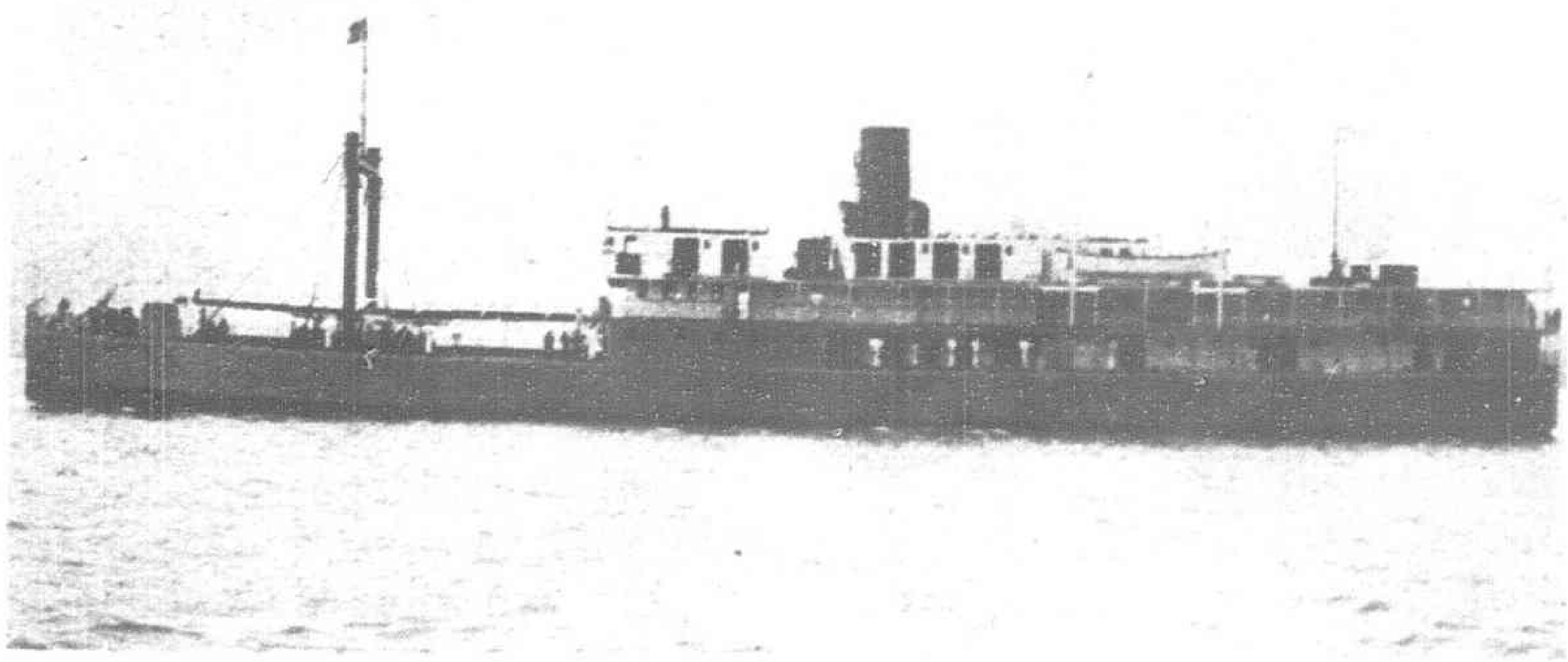
New Taikoo-Built Motorship is Launched

The m.v. *Wulin*, the latest ship launched by the Taikoo Dockyard and Engineering Co., Ltd., underwent a satisfactory trial, achieving a speed of just over 12 knots, fully loaded.

The vessel is built to the order of Messrs. The China Navigation Co., Ltd. for service on the Yangtze River. Her dimensions are 260-ft. 0-in. by 50-ft. 0-in. by 10-ft. 6-in. moulded to the main deck; she has a gross tonnage of 2,500 tons and has scantlings approved by the British Corporation.

The vessel has two complete decks with long promenade and boat decks, five watertight bulk heads, double bottom under the machinery, and three large cargo holds and cargo 'tween-decks.

Accommodation is provided on the promenade deck for saloon-class passengers in double and single-berth cabins, with large dining-saloon and smoke room. Cabin class and steerage passengers are carried on the upper deck.



The motor vessel "Wulin" on trial run

Arrangements for handling cargo are provided in the form of steel derricks capable of dealing with weights up to 15 tons. The winches for operating these are electrically driven.

The steering gear is fitted over the rudder head, electrically driven and controlled from the bridge by telemotor. An electric windlass is fitted forward for operating the anchors and cables. Large cold storage rooms are provided, cooled by machinery supplied by Messrs. J. & E. Hall, Ltd.

The Diesel propelling machinery, as well as the auxiliaries, have been built by the well-known firm of Messrs. Sulzer Bros., Winterthur, and are of their latest two-stroke solid-injection type.

The Taikoo Dockyard have now become special licensees for the building of Sulzer Diesel machinery in collaboration with the patentees and are commencing construction shortly.

The Iraq Pipe Line*

On January 14, King Ghazi of Iraq formally opened the great pipe line, pumping, and oil storage system, which has been successfully carried out by the Iraq Petroleum Company, Ltd., an international company, representing British, American, French, and Dutch oil interests. We reproduce herewith a sketch map of the two pipe lines which run side by side from Kirkuk to Haditha, on the river Euphrates, where they separate, the northern or French section cutting across the desert to Tripoli, while the British section, continuing almost in a straight line, stretches in a south-westerly direction to Haifa. Some typical views of the pipe line, one of the pumping and one of the terminal station, are reproduced.

An Historical Survey

Before dealing with some technical aspects of the undertaking, some short reference to the long history of the Iraq oilfield and its development is called for. From the beginning of history until well into the nineteenth century the oil resources of north-eastern Iraq were ignored, and practically unsuspected, save perhaps for the riverside peasant's use of a hand scoop of seepage oil for kindling his fire, rubbing his camel's back, or perhaps smearing with bitumen the skin of his river coracle. In the late decades of last century seepages were let year by year by the Government, and some primitive oil refining was begun locally. For many years the surface indications of sulphur, water gas, and bitumen had been noted and spoken of by travellers, and mention had been made of the " burning fiery furnace " of Baba Gurgur, which they doubtlessly connected with the Mosque of Daniel, the Prophet, at Kirkuk. At the beginning of this century, however, increasing interest was taken in the oil-bearing territories, alike by British, American, and German concessionnaires, and oil rights were freely canvassed in connection with the projected Baghdad Railway. Negotiations were delayed by the Turkish Revolution of 1908 and 1909, but by 1911 a British company, with German and later (through Sir Henri Deterding) Anglo-Dutch participation, styled African and Eastern Concessions, Ltd., had been formed, and is the direct ancestor of the Iraq Petroleum Company of to-day. Twice before the war and again in 1914 it was reconstructed and was then known as the Turkish Petroleum Company. Shortly before the outbreak of the war, following laborious negotiations by Mr. Greenway (now Lord Greenway), Mr. C. S. Gulbenkian, and Mr. H. E. Nichols, the company succeeded in obtaining from the Turkish Government the grant of a concession for the oil deposits of the Mosul and the Baghdad Wilayats. Owing to the war, however, eleven years elapsed between the Turkish grant and the signature of a regular convention by the Government of Iraq, which had taken over those territories. In March, 1925, the company, with powerful French and later American participation, began its work, and offices were established in Iraq, at Baghdad, Tuz, and Kirkuk, and geological surveys were begun. Drilling started in April, 1927, and many test bores were completed. In October of that year the first oil was obtained from the gusher at No. 1 well at Baba Gurgur, and up to the spring of 1931 eight more wells were put down. The Convention of 1925 provided for the construction of a pipe line by the company, but no capacity was then named, and in January, 1928, a trans-desert survey was carried out by Lieut.-Colonel J. Hay, of the Anglo-Persian Oil Company.

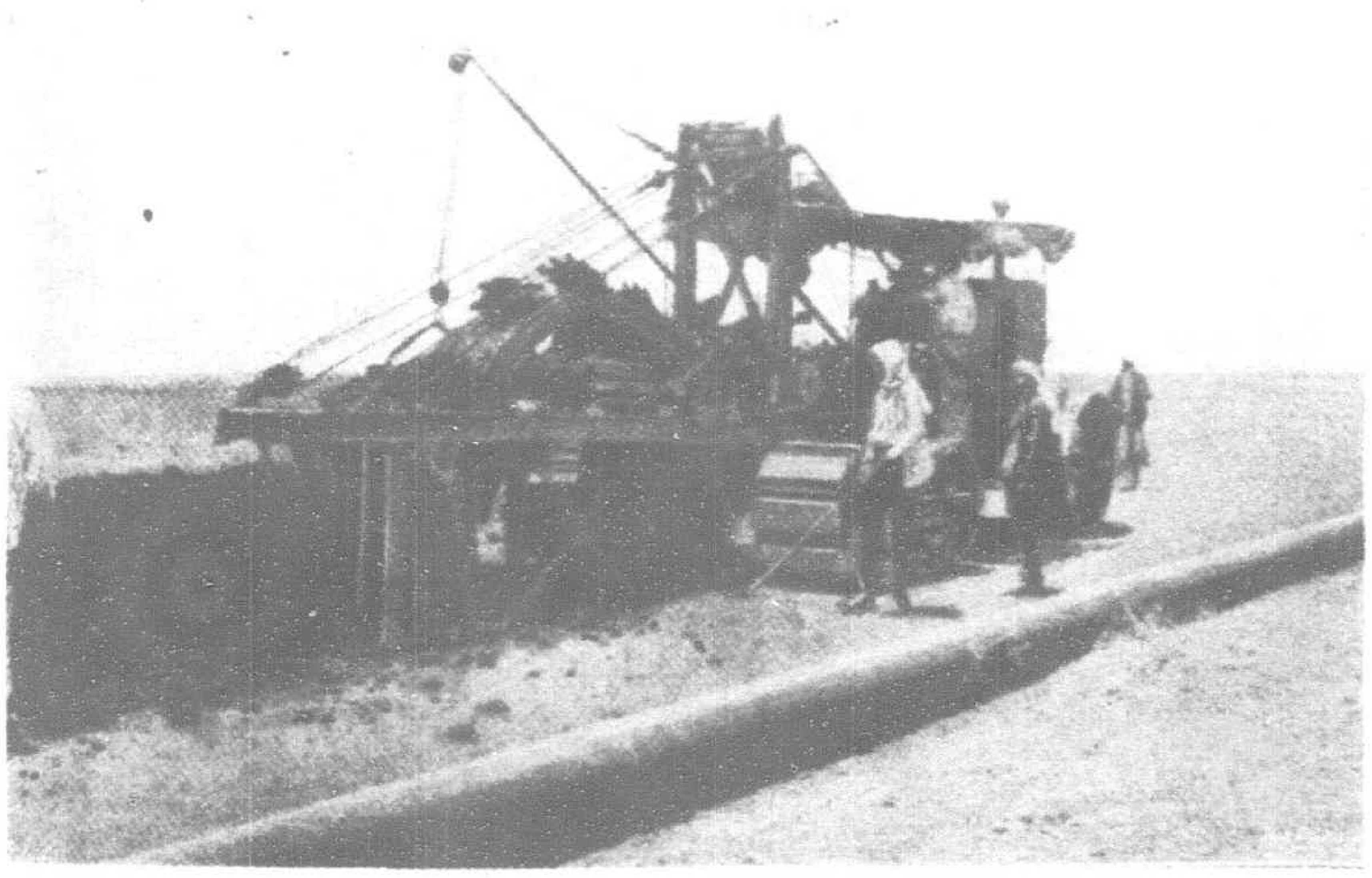


Fig. 1.—Buckeye Ditcher at work on the Iraq Pipe Line

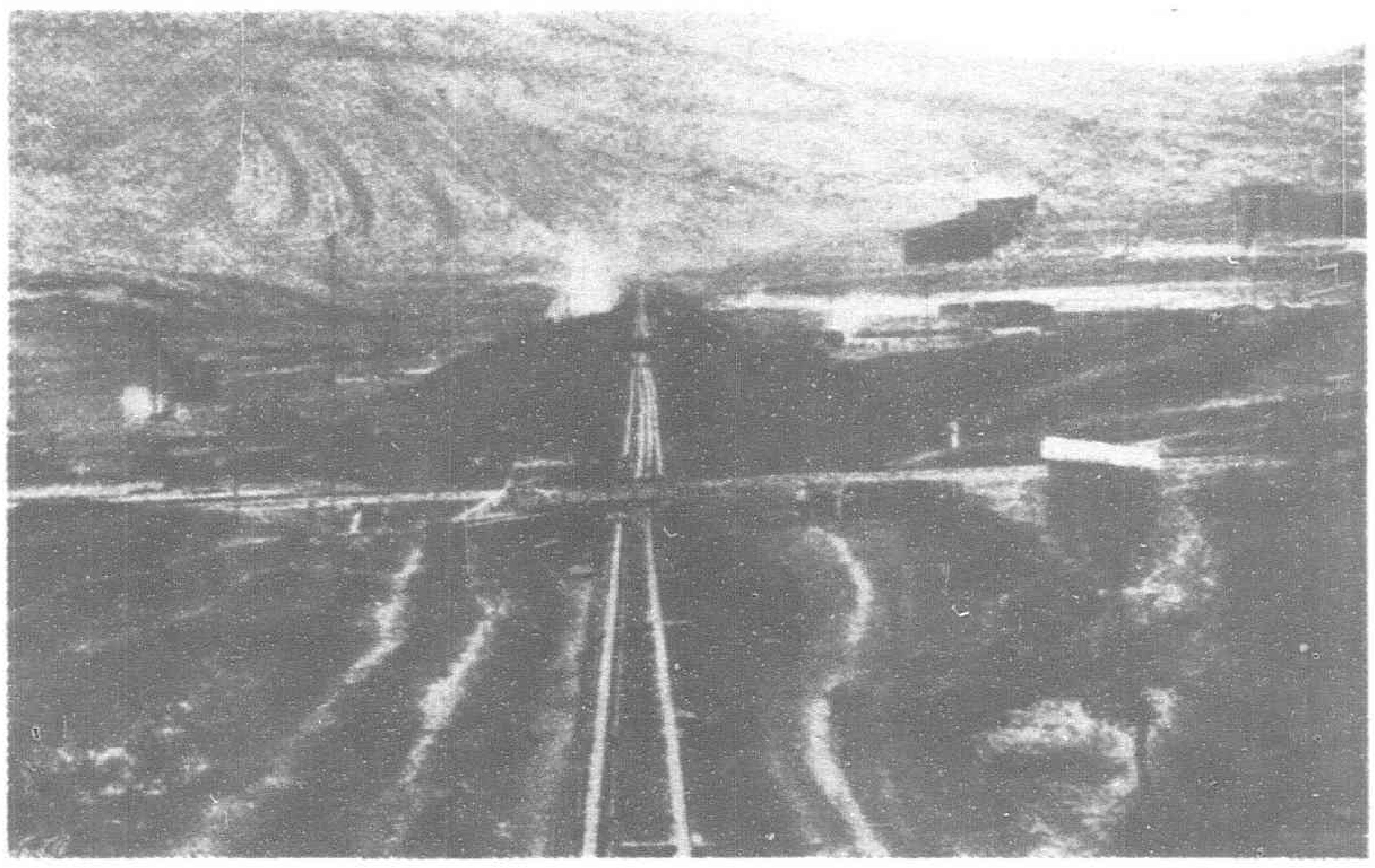


Fig. 2.—Tripoli terminal of the Iraq Pipe Line looking inland

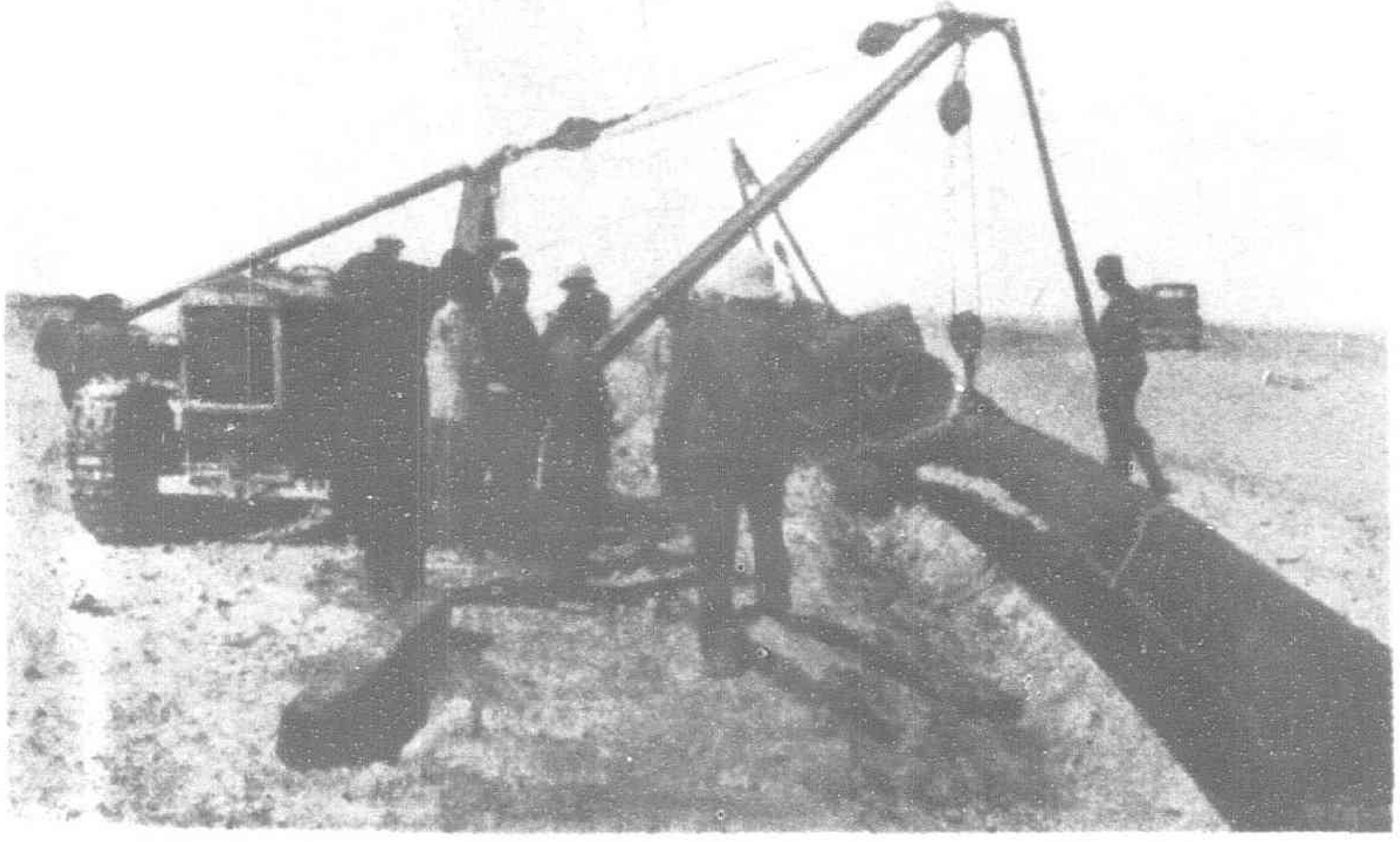


Fig. 3.—Pipe bending operations on the Iraq Pipe Line

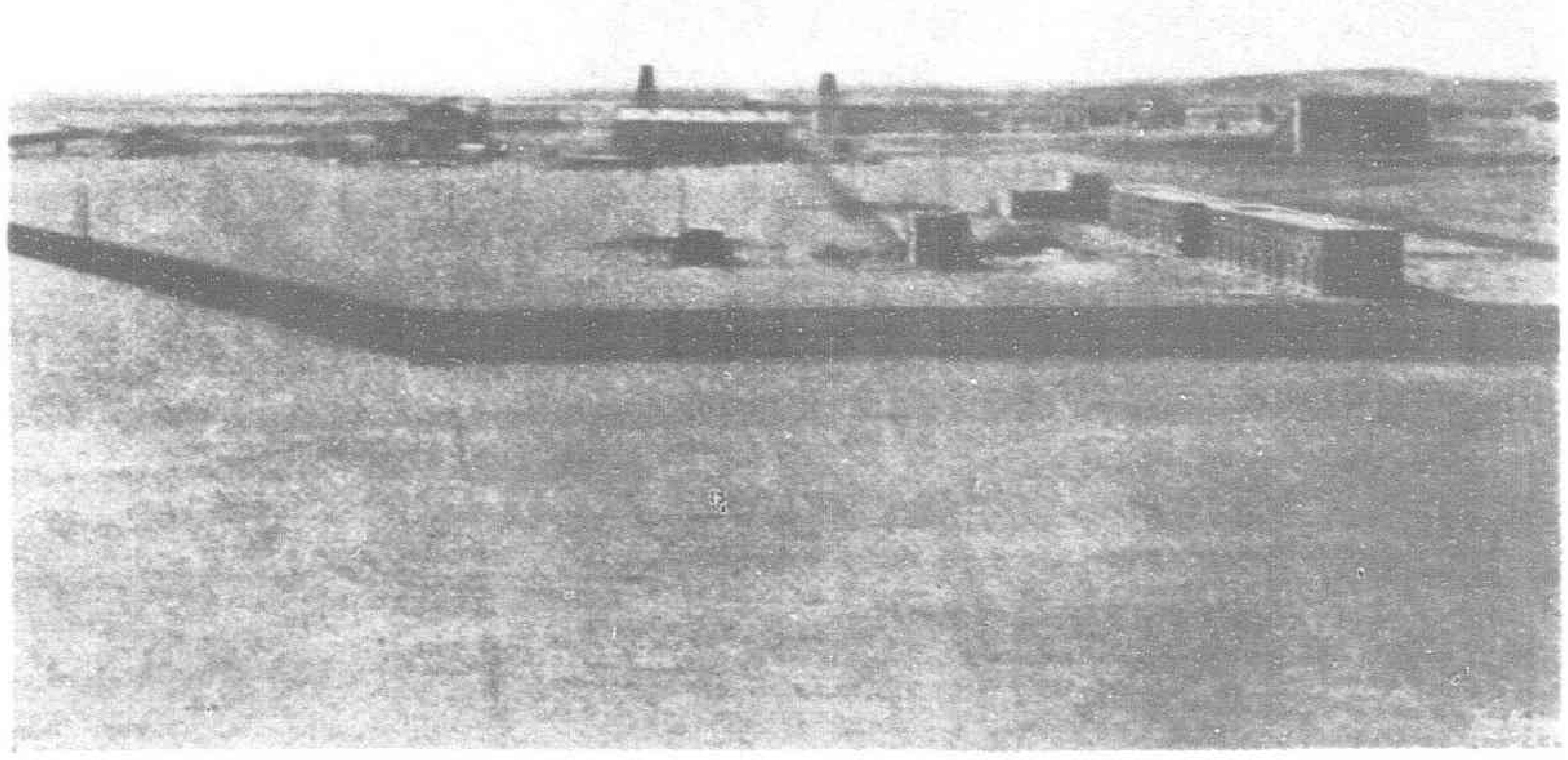


Fig. 4.—General view of T-4 Station, Iraq Pipe Line

**The Engineer*

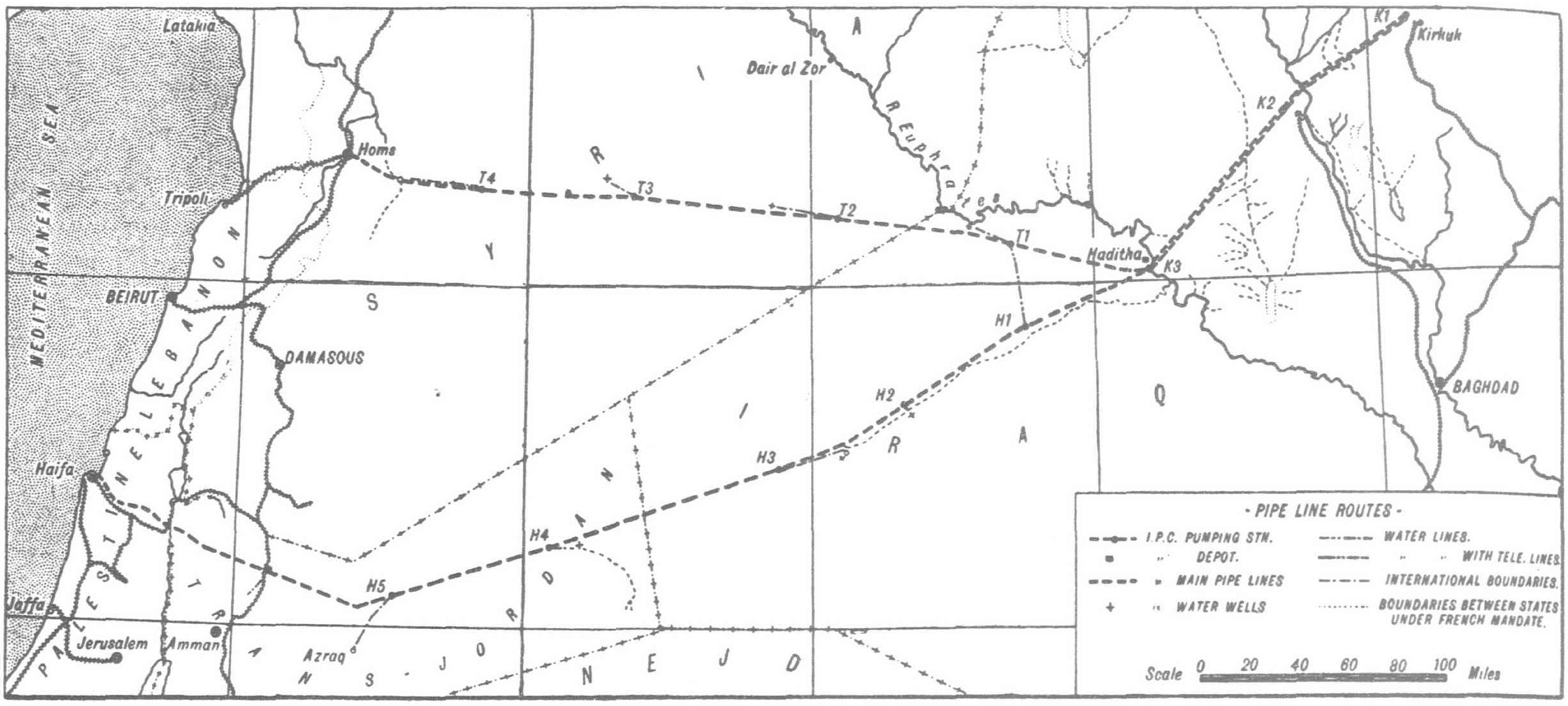


Fig. 5.—Sketch map of the routes followed by the Iraq Pipe Lines

This work was continued until 1930 by British, American, and French engineers. In the autumn of that year, following field work by Mr. H. A. Hammick and Monsieur Parmentier, a decision was made to bifurcate the line at a point on the Euphrates, and to carry it to the sea through Syrian and Lebonese territory on the north, and through Trans-Jordan and Palestine on the south. In the mid-winter of 1930 to 1931 a further study of both lines was made by Mr. H. S. Austin, the president of the Ajax Pipe-Line Company, and Mr. H. M. Stevenson, of the Humble Pipe-Line Company, and Mr. Douglas, and the general hydraulic and mechanical data necessary for designing the line were obtained. The routes were first marked out with cairns by three survey parties controlled by Mr. Hammick and Mr. R. J. Johnson in the summer and autumn of 1931. Some important changes, both with regard to the development of the field and the pipe line, were made when the company's Convention of March, 1931, with the Iraq Government was signed. Under that Convention it was provided that the company should produce not later than August, 1931, plans for a pipe line system of a yearly minimum capacity of 3,000,000 tons. It was further provided that the work was to be completed by December 31, 1935. The work has been accomplished at a cost, it is estimated, of not less than £10,000,000, and the company, its officials and engineers must be congratulated on the success of their work. Special mention must be made of the initiative and guidance shown by Sir John Cadman, who took a leading part in the work and who negotiated with the Iraq Government the Revised Convention of 1931, which to-day constitutes the company's charter. In the same year Conventions were successfully negotiated with the Governments of Palestine, the Lebonese Republic, and the State of Syria in order to permit the passage of oil through those territories.

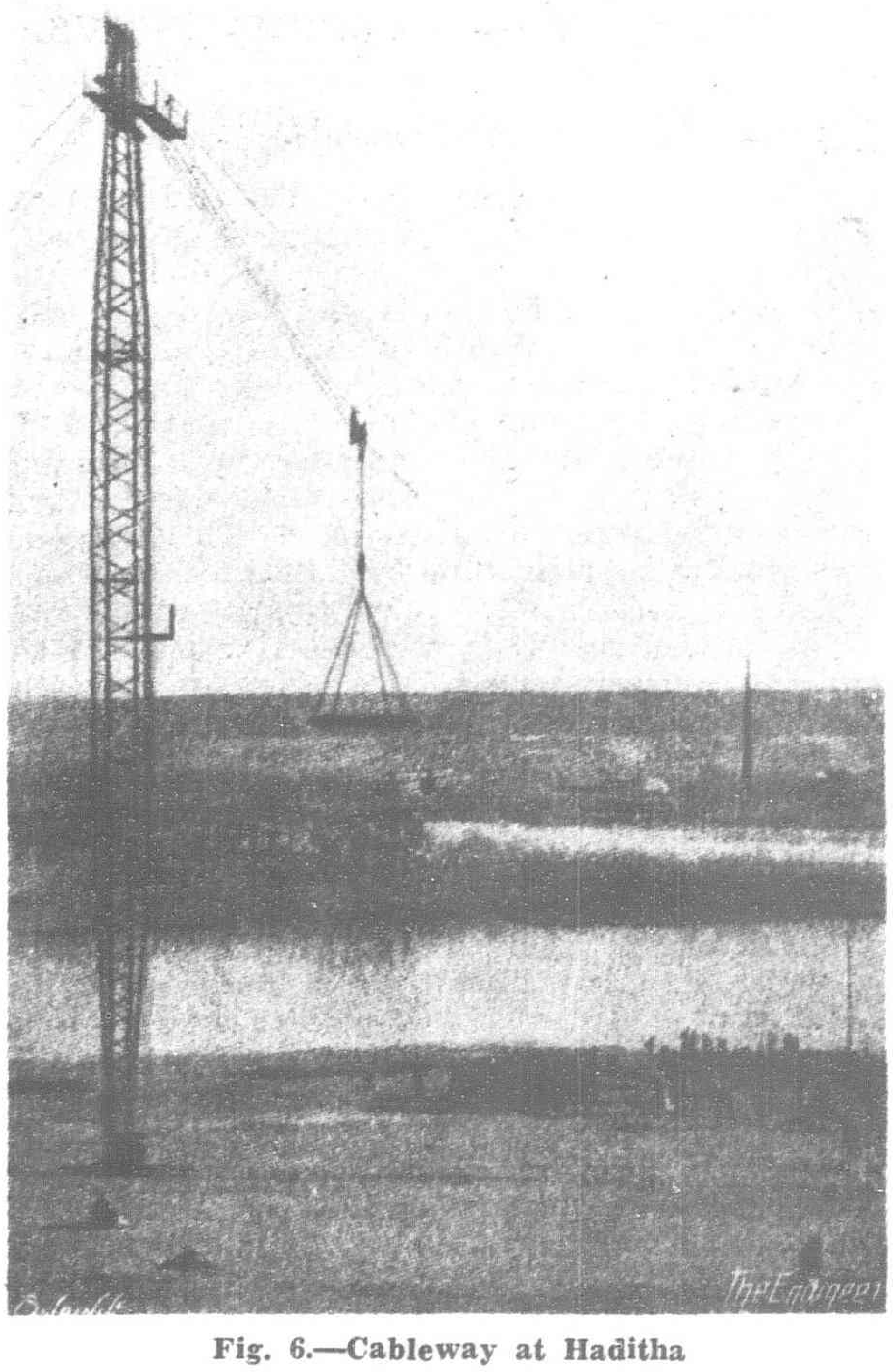


Fig. 6.—Cableway at Haditha

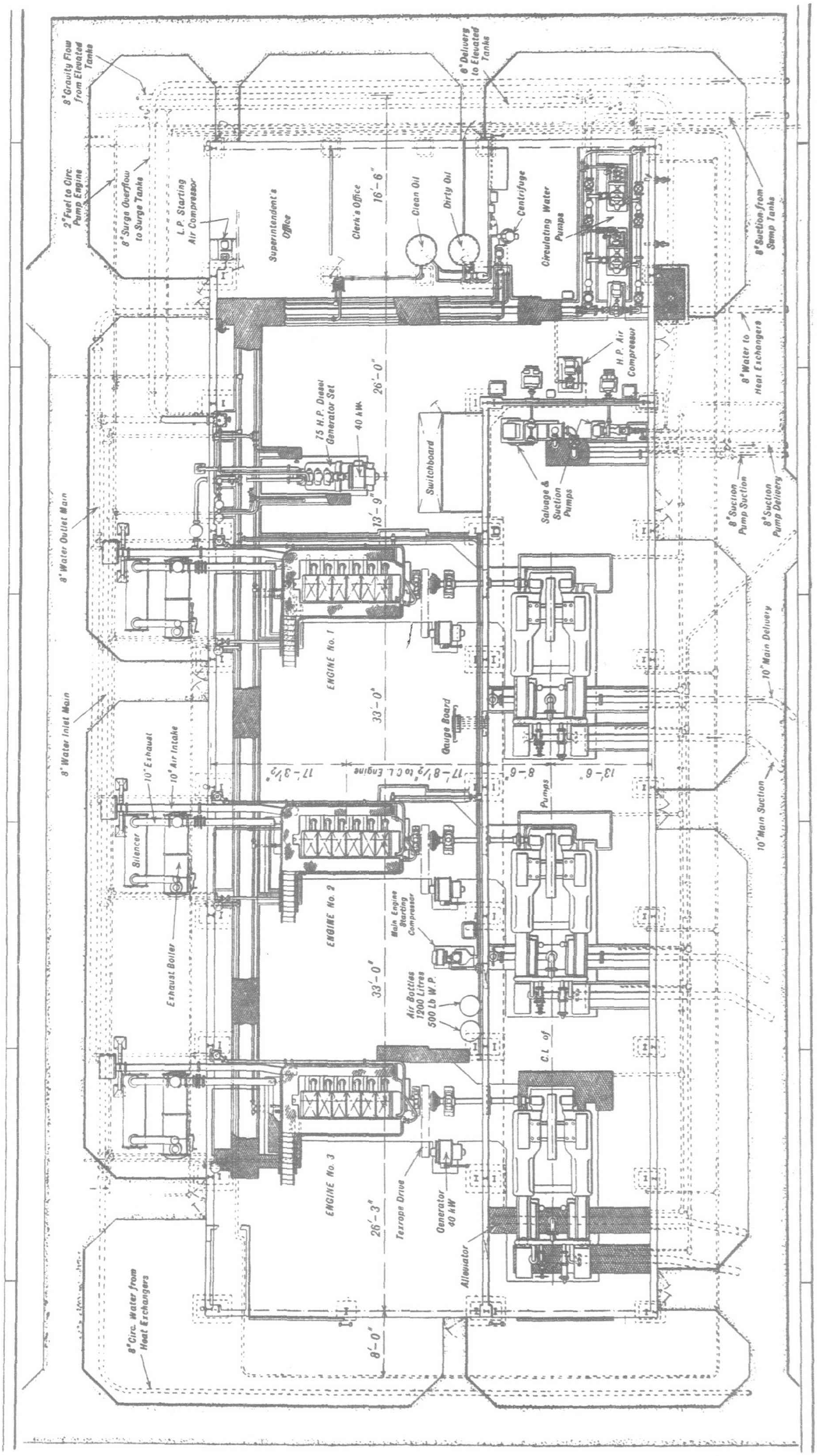
The Pipe Line Design

The design adopted provided for the construction of a line which would deliver half at Tripoli and half at Haifa, a daily average of 85,000 U.S. barrels, or 11,200 tons, of Kirkuk crude oil of 0.8416 density and 45 secs. viscosity (Redwood) at 70 deg. Fah. With the ascertained alignment and profile of the country, a line of 12-in. pipe working at 700 lb. per square inch maximum pressure, and a 10-in. pipe working at 880 lb. per square inch pressure, were found to meet the requirements. The pipes employed were to be of bell-ended seamless steel tubes, in lengths of 36-ft. to 40-ft. welded end to end over a chill ring. The 12-in. pipe selected had a thickness of 0.33-in., and a weight of 43.73 lb. per foot, while the 10-in. pipe had a thickness of 0.307-in., with a weight of 34.24 lb. per foot. For use on a single section 8-in. pipe was chosen, with a thickness of 0.322-in. and a weight of 28.25 lb. per foot. Special heavy pipe was specified for under-water work, and specially high pressure conditions, and was plain ended with clamps over all submerged joints. The 12-in. pipe of this design was ½-in. thick and weighed 65.45 lb. per foot, while similar 10-in. pipe was 0.365-in. thick and weighed 40.48 lb. per foot. The 12-in. main pipe was supplied by the Comptoir Franco Belgo Sarrois, Stewarts and Lloyds, Ltd., the Bromford Tube Company, Ltd., the British Mannesmann Tube Company, Ltd., the Oil Well Engineering Company, Ltd., and certain German pipe-manufacturing firms, and the heavy 12-in. pipe was made by Stewarts and Lloyds, Ltd., and the Bromford Tube Company, Ltd. The total 12-in. pipe amounted to 5,362,000-ft., with 152,693 sleeves, and 148,352 joints, and weighed 110,874 metric tons.

The 10-in. main line pipe was manufactured by the British Mannesmann Tube Company, Ltd., Stewarts and Lloyds, Ltd., and the Oil Well Engineering Company, Ltd., together with German and American pipe manufacturers; the Oil Well Engineering Company and the National Tube Company, of America, supplied the heavy pipe. This 10-in. pipe amounted to 1,018,000-ft., with 28,250 sleeves and 27,259 joints, and weighed 15,068 metric tons. The 8-in. pipe, supplied by Stewarts and Lloyds, Ltd., consisted of 78,000-ft. of pipe, with 1,340 sleeves and 2,107 joints, and weighed 1,059 metric tons.

It was decided to weld by electricity, and not to use gas, in conformity with practice during the past few years in American pipe line work. By this means the problem of transporting welding gas was done away with and, we are informed, the electric welding method was fully justified by the results obtained. The general lay-out of the pipe line and the stations is clearly indicated in Fig. 5. The double line from K-1 to K-3 is designed to operate normally as a single line, though provision has been made to operate the two lines separately. Oil is propelled along the pipe lines by twelve pumping stations, the first of which is built on the edge of the Kirkuk structure, some five miles from Kirkuk. It is followed by K-2, 10 miles to the west of the Tigris, and K-3, 1½ miles east of the Euphrates. These are all double stations, each designed to pump 85,000 barrels, or 11,200 tons of oil per day.

After the bifurcation of the pipe lines at Haditha, the northern line passes through four stations, T-1 to T-4, each of which has a designed capacity of 42,500 barrels, or 5,600 tons per day; while on the southern line there are five stations, H-1 to H-5, which are of the same capacity. A view of one of the completed stations, T-4, is reproduced in Fig. 4. The decision to install Diesel oil engines to drive the pumps was influenced by the general scarcity of water and the ease of obtaining oil fuel, and it was found that a total of forty-five four-stroke cycle oil engines, each of 500 b.h.p., operated at between 210 and 330 r.p.m. would supply the necessary power. We propose to deal with the engines, pumps and auxiliary machinery equipment in our next article. The tankage requirements of the line were dealt with by the provision of six large 93,000 barrel or in some cases 10,000 ton tanks at K-1, two 30,000 barrel tanks at K-2, and five large tanks at K-3. At T-1, T-2, and T-4 stations there is one small tank and at T-3 two small tanks. At the four stations H-1, H-2, H-3, and H-5 there is one small tank, while at H-4 and also at the Jordan Relief Station two each are provided. There are fifteen large tanks at the Tripoli terminal—see Fig. 2—while at the Haifa terminal station there are ten tanks with five more on the reclaimed area which adjoins the new Haifa harbor.



Single-Type Pumping Station on the Iraq Pipe Line

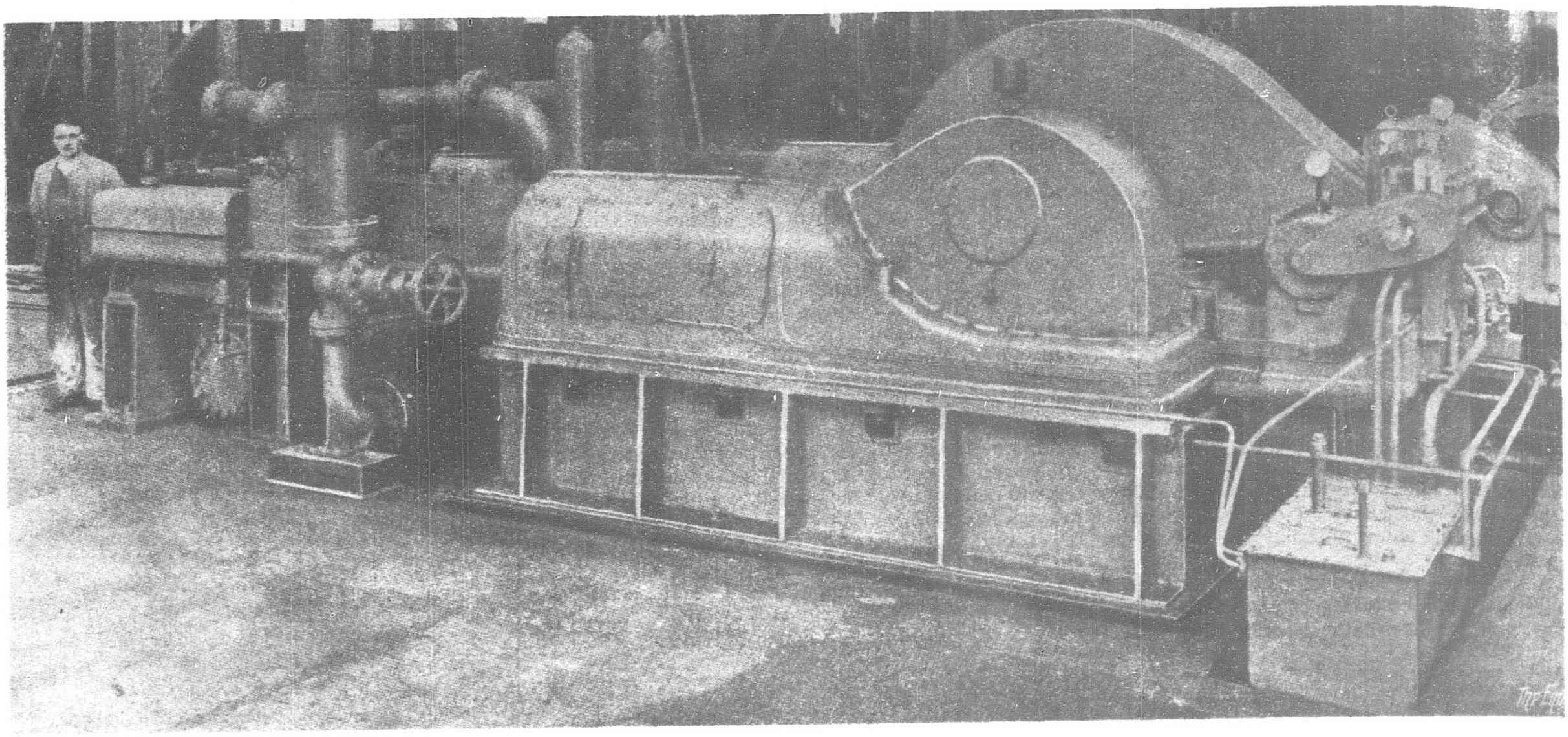


Fig. 7.—Iraq Pipe Line—Main Oil Pump in Makers' Works

Pipe Line Construction

The final alignment of the line was made by survey parties in the summer, autumn, and early winter of 1931, and from the November of that year until the February of the following year a period of active construction was begun. By March, 1932, representatives of the engineering and service departments had arrived. In May, 1932, the engineers were engaged in a preliminary and experimental clearance in the lava country, which was later followed by road construction. Finally steps were taken to make good an essential link in the chain of communications by the erection of overhead cableways or " Blondins "—see Fig. 6—over the Tigris and Euphrates rivers. The workmen employed increased from 916 in May to 1,735 in June, 2,620 in July, and 4,787 in August, in addition to which there were the European engineers and supervisors. Such important matters as construction depôts, river crossings, and road construction were carefully considered, as also were the telephone and telegraph services, living, and hospital accommodation. For transporting pipes and material use was made of the available railway services, but in addition a large fleet of motor transport vehicles had to be established. These included large-capacity trucks for main pipe haulage, medium and small-capacity vehicles for service operation, motor tank wagons for the conveyance of water and petrol, and passenger vehicles for the use of the executive and supervisory staffs. The vehicles were supplied by leading British, American, and Continental motor manufacturers. We show in Fig. 1 one of the Buckeye ditchers used for making the trench in which the pipes were laid, and in Fig. 3 a typical pipe laying and bending operation. Special features of the transport vehicles were the large tire contact area and the generous ratio of tire capacity to weight. Extensive use was made of fully articulated vehicles. In all cases provision was made for an unusually large power weight ratio and air filters for the engines. The work of laying, welding, and burying the main pipe lines was preceded by the laying of the line under the Euphrates and Tigris rivers and was entrusted to four gangs. After the main pipe line was finished the welding operatives occupied themselves with the tank and pump house connections, the heat exchangers, and the floating tank roofs, the welders being employed for some months in 1934. Besides the telephone and telegraph communication services there was a wireless service and an aircraft communication service, while a complete system of water supply was created by drilling wells and installing pumping plant and pipe lines from the great rivers.

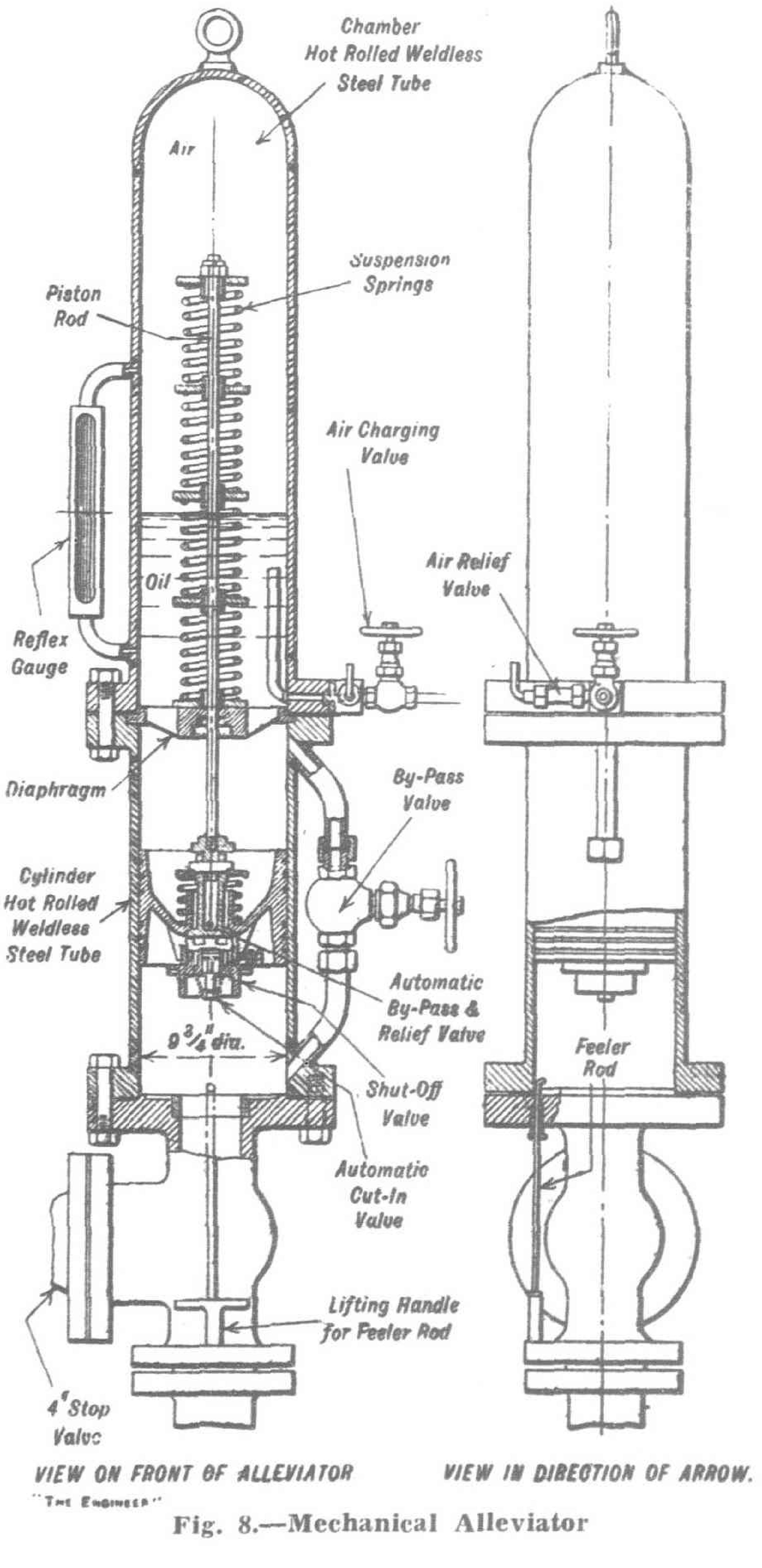


Fig. 8.—Mechanical Alleviator

The Pumping Stations

There are twelve pipe line pumping stations, the functions of which are to supply power to enable the oil to overcome the frictional resistance of the pipes and pass down the line at a velocity high enough to give the designed rate of flow; to act as control points for checking the flow; and to form suitable bases for line repair and maintenance. As indicated in the map, the stations fall into three groups. The K stations between Kirkuk and Haditha, K-1 to K-3; the H stations between Haditha and Haifa, H-1 to H-5; and the T stations between Haditha and Tripoli, T-1 to T-4. Of these, the T and H groups are practically identical, while the K stations differ only in having double the pumping capacity. The single stations, one of which is shown in plan, are designed to pump 42,500 barrels of oil per day, while the double stations have a designed pumping capacity of 85,000 barrels. A view reproduced in Fig. 9 shows a typical main station with its pump house, the tanks for oil fuel and water storage, and the buildings for

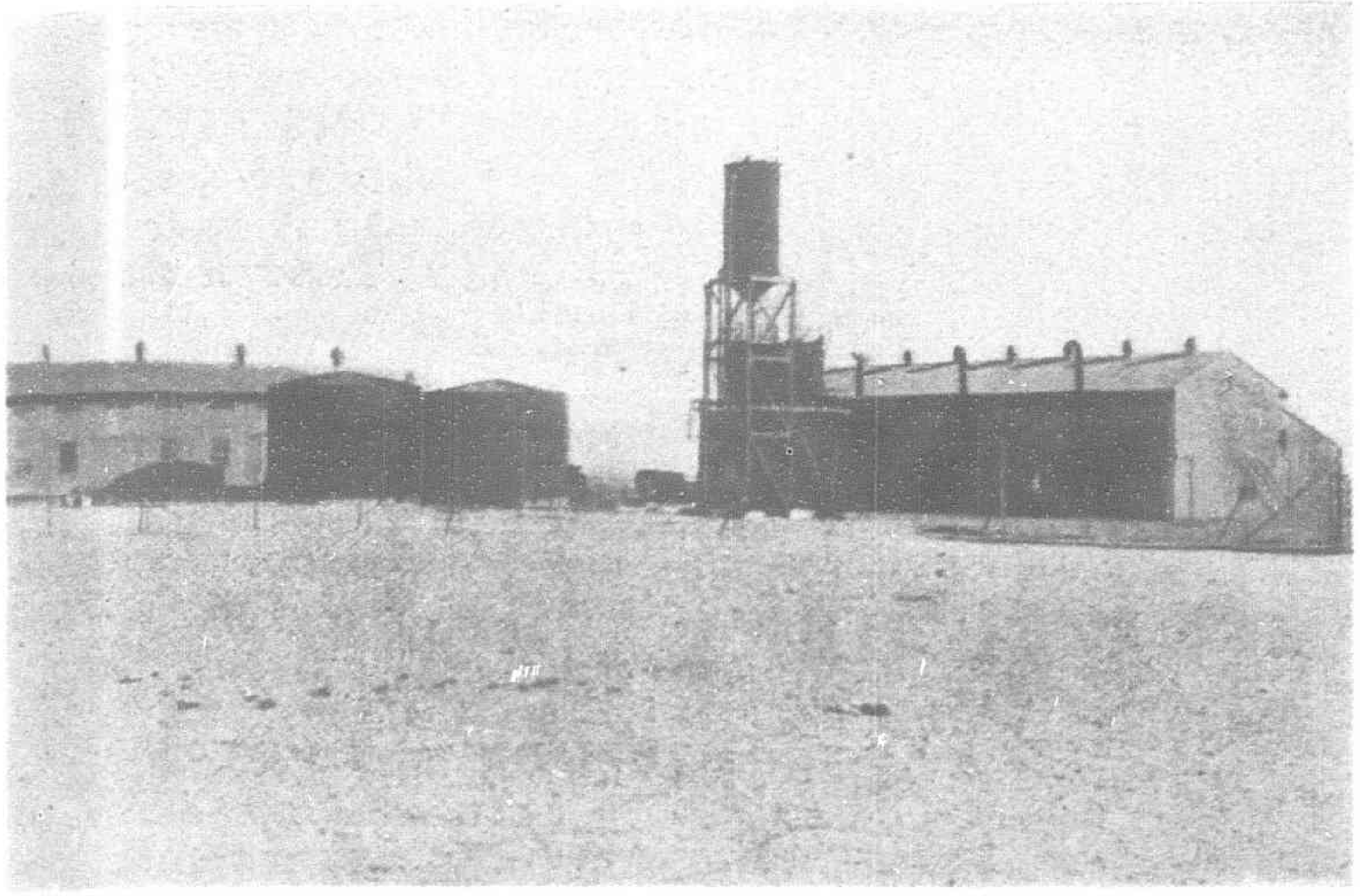


Fig. 9.—A typical pumping station on the Iraq Pipe Line

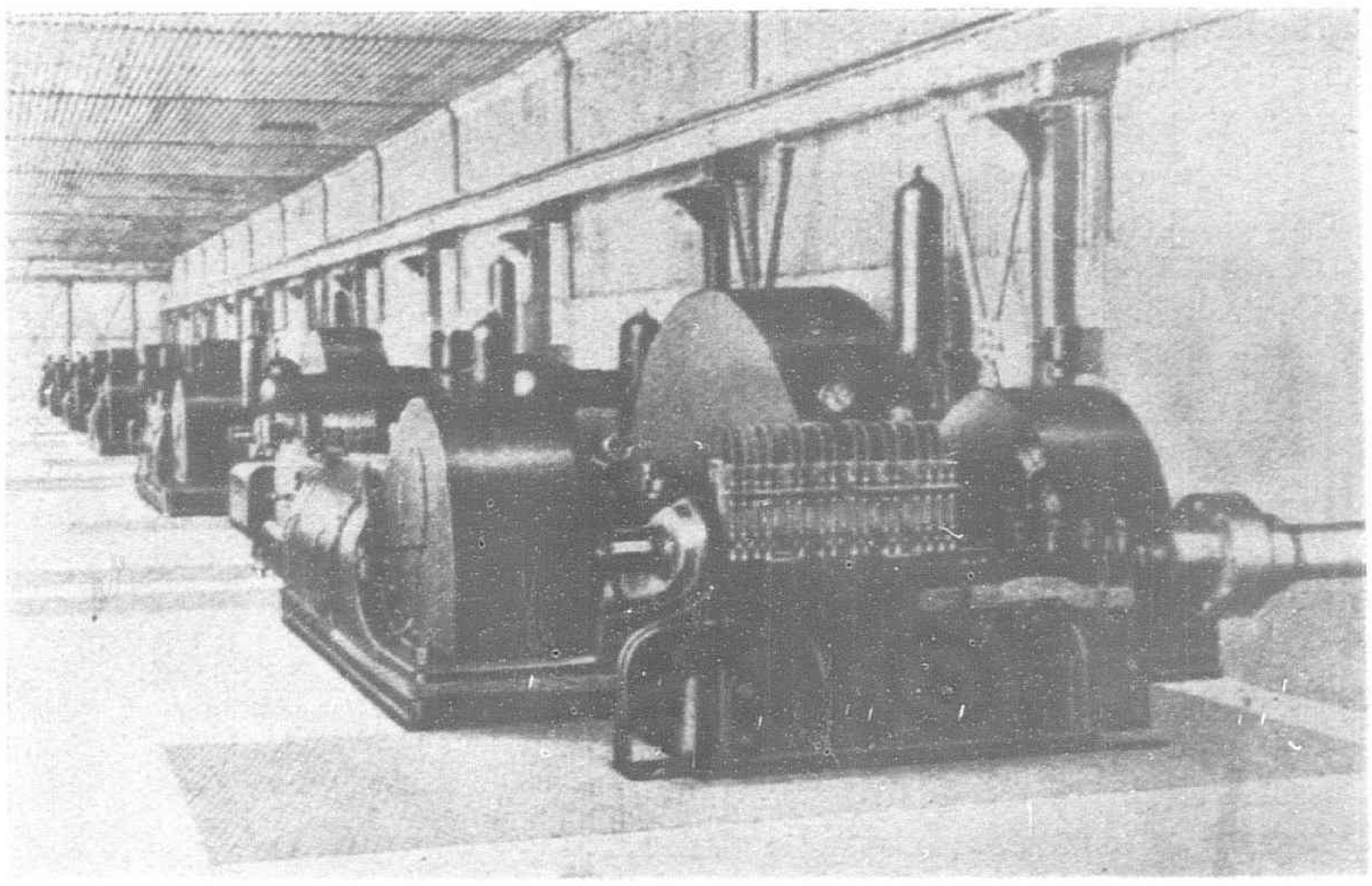


Fig. 10.—Oil Pumps at K 3 Station on the Iraq Pipe Line

general stores, etc. The buildings are enclosed within a strong fence of expanded metal, the main entrance to which is floodlighted. The general design of the enclosure is such as to provide an adequate defence against possible pilfering, trespass, or the milder forms of attack. Outside the area enclosed there is space reserved for a landing ground for aeroplanes. As may be gathered from the drawing reproduced—Fig. 9, the pump and engine house is a steel-framed building, with a corrugated galvanized iron covering. It has a width of 56-ft. 6-in. and a length of 148-ft. 6-in. for single stations, and 247-ft. 6-in. for the double K stations. A view of the pump house of one of these double stations is reproduced in Fig. 10. This view shows the fireproof wall between the pump room and the adjoining engine house, also the crane gantry and lighting arrangements. The buildings were all supplied by Redpath, Brown and Co., and they have steel windows and concrete floors, with a "bowstring" ceiling of crimped galvanized iron. The service cranes for the pumps and engines were supplied by Herbert Morris, Ltd., of Loughborough. All the main pumps, forty-five in number, together with a complete spare pump, were designed and supplied by Worthington-Simpson, Ltd., of Newark-on-Trent, and Queen's House, Kingsway, London, W.C.2, which firm also supplied practically all the auxiliary pumps. The contract was gained in the face of keen Continental and American competition. The pumps have a bore of $6\frac{3}{4}$-in. and a stroke of 24-in., and are of the horizontal duplex double-acting type, with outside-packed plungers. They are driven by 500 b.h.p. oil engines through David Brown double-helical single-reduction gearing, which lowers the engine speed of 300 r.p.m. to a pump speed of 44 r.p.m., variations of power and speed being provided for. The design of the engines and pumping machinery was supervised by a special technical staff, and during the most strenuous period of work the Iraq Petroleum Company, Ltd., had the advantage of the advice on all technical matters of Mr. J. A. Jameson, acting as the representative of the chairman, and of the assistance of Mr. A. C. Hartley, Mr. L. J. Le Mesurier, Mr. D. M. Maclachlan, and Mr. R. Allan Brown in various branches of engineering; Mr. H. S. Austin was appointed head of the department in London for the design and construction of the pipe line in 1930, and he acted in that capacity throughout the whole period of construction.

Some Machinery Details

In choosing suitable oil engines, the remote characters of the stations and the special conditions under which the plants were called upon to operate, were specially borne in mind. Careful attention was given to such factors as enclosure against dust, the recovery and reconditioning of lubricating oil, the special character of the crude fuel oil, and its efficient combustion, and conditions for easy and certain starting. It was decided to place the orders for the forty-five 500 b.h.p. engines, of the five-cylinder, four-stroke, airless-injection type, with three leading engineering firms. For the three K stations eighteen Sulzer engines were supplied by Sulzer Brothers (London), Ltd., nine being manufactured under agreement by Armstrong Whitworth (Engineers), Ltd., at Newcastle-upon-Tyne, and nine by the Compagnie de Construction Mécanique Procédés Sulzer, of Paris. All the engines for the T stations were built by Werkspoor, of Amsterdam, while the H stations were supplied with engines built by Harland and Wolff, Ltd., of Belfast. The general lay-out of a single station may be studied from the drawing reproduced, a special feature being the gas-tight wall between the pumps and engines.

One of the main pumps is illustrated in Fig. 7. The complete unit has a length of 25-ft., with a breadth of 10-ft. 3-in., and a height of 5-ft., and weighs just over 25 tons. All the units are designed to operate under a service pressure of 800 lb. per square inch, and are designed to deliver a total of over three million Imperial gallons of crude oil per day to the Mediterranean Coast with one-third of the units acting as standby plant, thereby allowing one engine in three to be shut down every two weeks for cleaning and

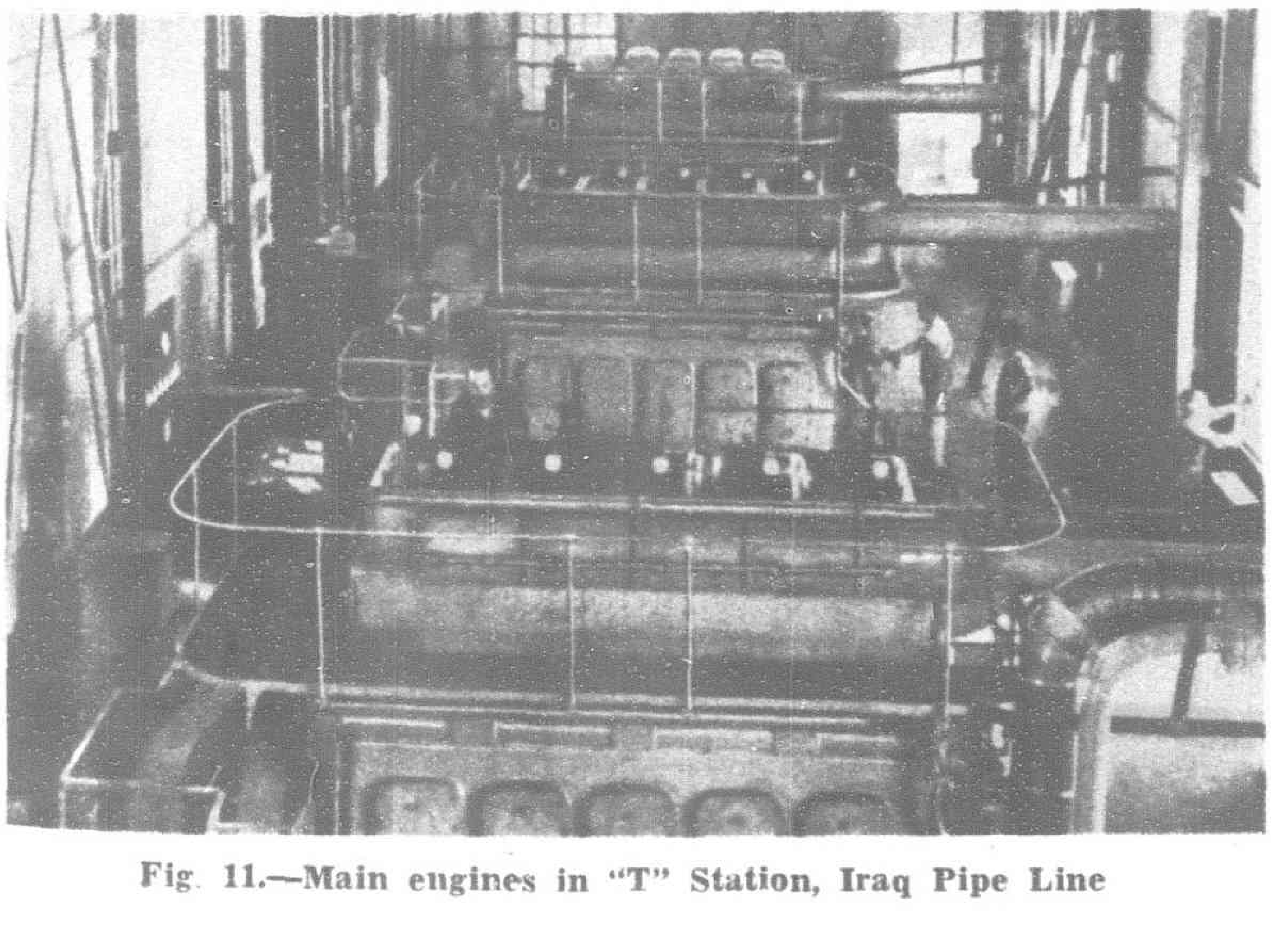


Fig. 11.—Main engines in "T" Station, Iraq Pipe Line

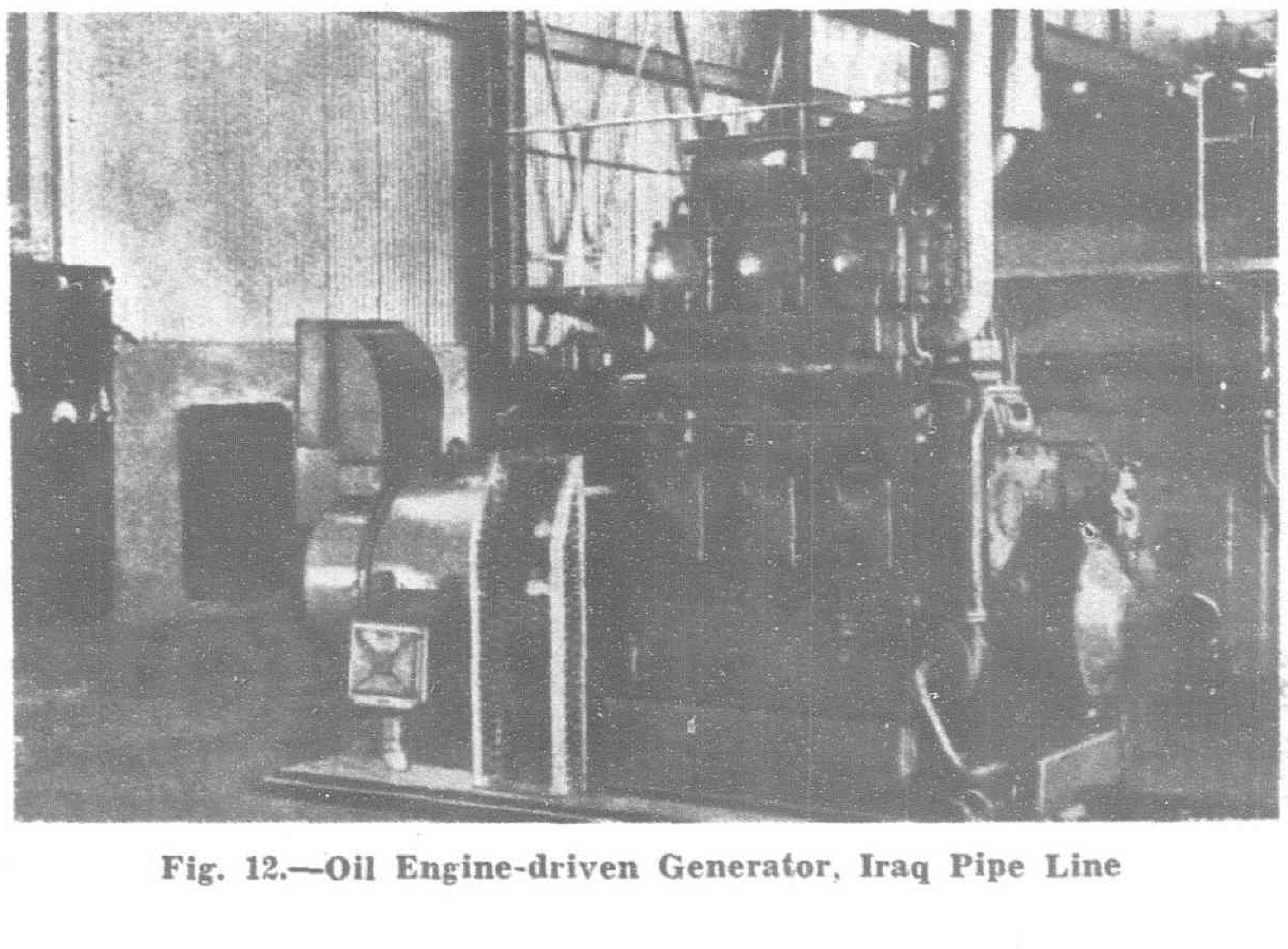


Fig. 12.—Oil Engine-driven Generator, Iraq Pipe Line

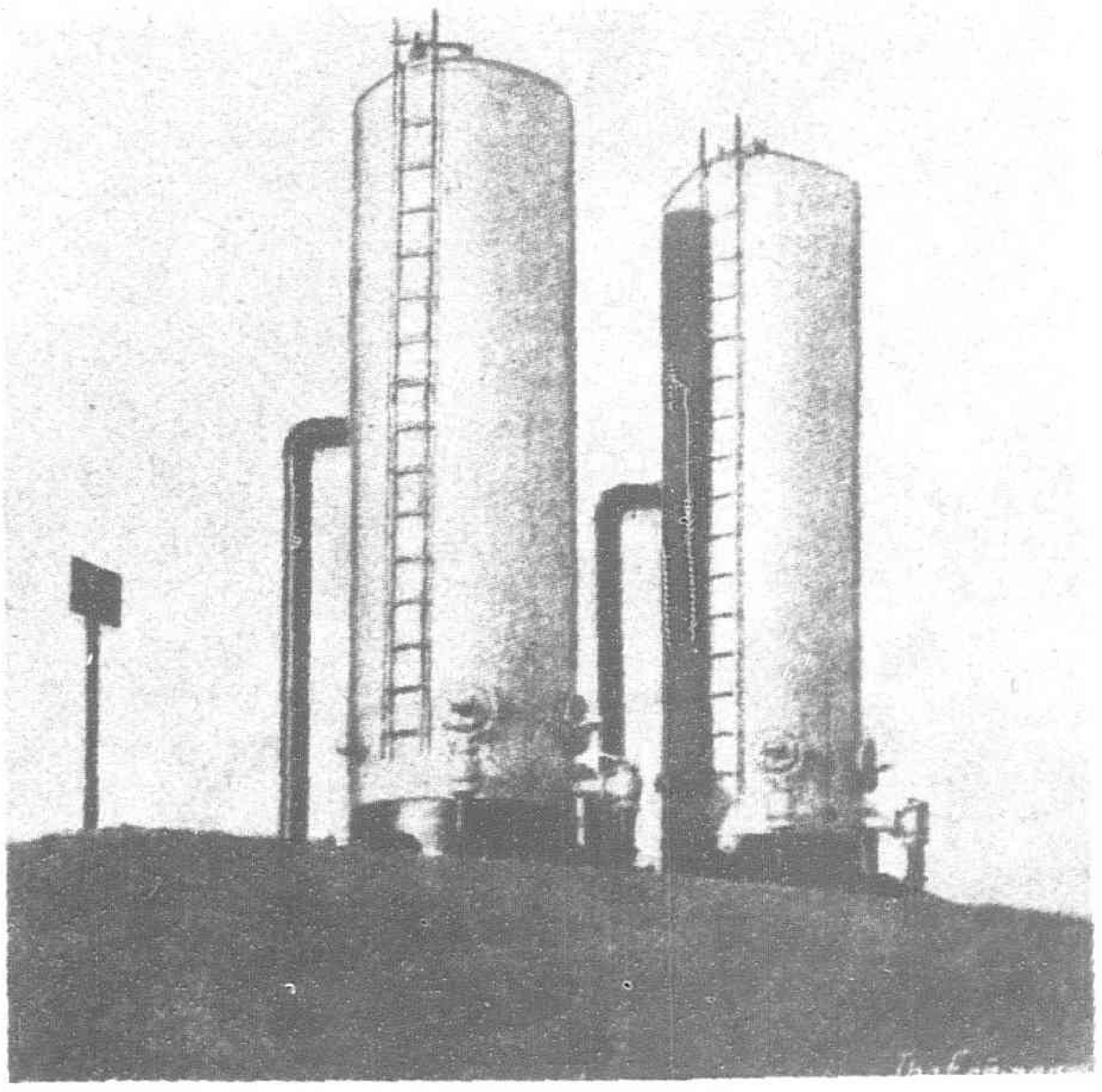


Fig. 13.—Gas Separators

adjustment. As previously mentioned, the plungers have a diameter of 6¾-in., with a stroke of 24-in., the corresponding total duty being 21,000 barrels of oil per day with the pumps running at 44 r.p.m., and the engine at 300 r.p.m. The design of the plungers and barrels, however, is such that if at a later date increased capacity is needed, 7-in. plungers can be fitted. The power end of the pump—see Figs. 7 and 10—is constructed in three parts for ease of transport. The two main side frames are tied together at the front end by the pinion shaft bearing bracket, and at the rear end by heavy cast iron distance pieces. The double-helical, single-reduction gear was designed and supplied by David Brown and Sons (Huddersfield), Ltd., to the order of Worthington Simpson, Ltd. The teeth are of the plano-generated double-helical pattern generated from the solid by means of profile-ground, rack-type cutters operating from either side of the gear wheel. Each set of gears comprises a large steel wheel, 6-ft. 7¾-in. in diameter, with a face width of 15½-in., meshing with a pinion approximately 12½-in. diameter at 45.41-in. centers. The wheel has 198 teeth of 2½ D.P., and is made in halves secured by fitted bolts. The pinion has twenty-nine teeth, and is formed in one with the shaft from a high-carbon solid steel forging. In order to prevent oil leakage grooves are formed on the shafts on either side of the wheel and pinion. The design adopted is such that the gears, we are informed, operate efficiently and quietly under day and night service and constantly varying loads, which may fluctuate between 270 and 470 b.h.p.

Continuing our description of the main pump, reference may be made to the closed crank chambers and the lubricating oil collecting sumps. The main bearings are lined with copper-antimony, hardened tin babbitt metal, and they are adjustable. The fluid ends of the pumps were made from specially selected forged steel ingots, machined all over, with the plunger chambers and suction valve boxes trepanned out, and with all the passages, ports, and recesses drilled from the solid. Before fitting the valve seats, which are of forged stainless steel, both the suction and delivery chambers were subjected to a test pressure of 1,200 lb. per square inch with kerosene over a continuous period of twenty-four hours, any change of pressure being noted by a recording meter. Similar tests were applied to the suction and delivery manifolds, which are made from solid-drawn steel tubes. The pump is furnished with by-pass relief valves from suction to delivery, which are used when starting, while, in order to absorb any shocks which may come on the line, and to smooth out further the flow so as to give quiet and gentle operation of the valves, a special type of mechanical alleviator has been fitted to each pump.

A section through one of these alleviators is reproduced in Fig. 8. It was designed by Wheatley Brothers, of Tulsa, Oklahoma, U.S.A., and was constructed under agreement by Worthington Simpson, Ltd.

The normal pattern of air vessel is not completely satisfactory when working with oil at high pressures, owing to the absorption of air, which necessitates frequent replenishment of the air supply. In the alleviator shown in Fig. 8, although a portion of the oil column is in contact with the air, the air and oil column in the top part of the cylinder is separated from the main oil system by a piston carrying six rings within which is a spring-loaded by-pass relief valve, a shut-off valve which automatically seats itself on failure of line pressure when the piston reaches the bottom of the cylinder and a small cut-in valve which admits oil through the piston and raises it when pressure is re-established. The air chamber is provided with a Klinger reflex gauge, and an air-charging and relief valve. By charging the chamber with 1,000 lb. pressure air, the requisite level can be regulated for maximum cushioning effect, and when once established the level is, we understand, maintained over very long periods without a further charge. There is a by-pass connection between the upper and lower ends of the chamber and a feeler rod is provided to test the position of the piston. The device is one which should prove very useful for high-pressure lines, whether for oil, water, or other liquids.

Another important feature of the main pumps is the enclosure of all the moving parts in gas-tight casings in order to prevent the contamination of oil by dust from sandstorms, etc. The reciprocating motion of the pumps is utilized to draw fresh air through Vokes Protectomotor type air filters into the casings, Worthington patented feather valves being used as intake and non-return valves. The filter inlets are fitted, as shown in Fig. 7, both at the back and the front ends on either side of the pump, the discharge being led outside the building into the sump. The lubricating system was specially designed, keeping in mind the high temperature which is experienced during certain parts of the year. As will be seen from the pump illustrated, there is a sixteen-feed Wakefield type visible forced-feed lubricator mounted at the front end of each pump with solid drawn connections to all moving parts and bearings. The oil is drained to an underground tank, where it is filtered and recirculated. At the back of the lubricator box there are four suction pumps, each with a capacity of 1½ pints per minute. These are coupled to each pinion shaft bearing and other parts of the main pump, the surplus oil being delivered to the under-ground tank, which is equipped with grille cooling, the oil being taken from the suction side of the main oil pump and passed through the cooling coils by a Worthington "Nuflo" rotary pump before being discharged into the lubricating system.

The drawing reproduced also shows the auxiliary pumps and the power and lighting generators. The main shaft between the engine and the pump operates a 45 kw. B.T.H. generator by means of a texrope drive, and these generating sets are attached to all units in the small stations and to the first four units in the large stations. As a standby a similar generator coupled direct to a 75 b.h.p., three-cylinder National oil engine is provided. Fig. 12 shows one of these auxiliary generating sets.

The auxiliary plant also includes three separate air supply systems in each station. For starting the National oil engine there is a Lister petrol engine driving a Reavell air compressor, which delivers air at 300 lb. per square inch. This air is utilized for starting and also for cleansing the Vokes Protectomotor pattern air filters. For starting the main engines Laurence Scott motor-driven air compressors, operating at a pressure of 570 lb. per square inch, is employed, the air compressors being of the Harland and Wolff type in the H stations and of the Reavell type in the K and T stations. The third air system has an operating pressure of 1,000 lb. per square inch, and is used for charging the alleviators on the main pumps. The compressors are of the Reavell pattern and are driven by Laurence Scott motors. The

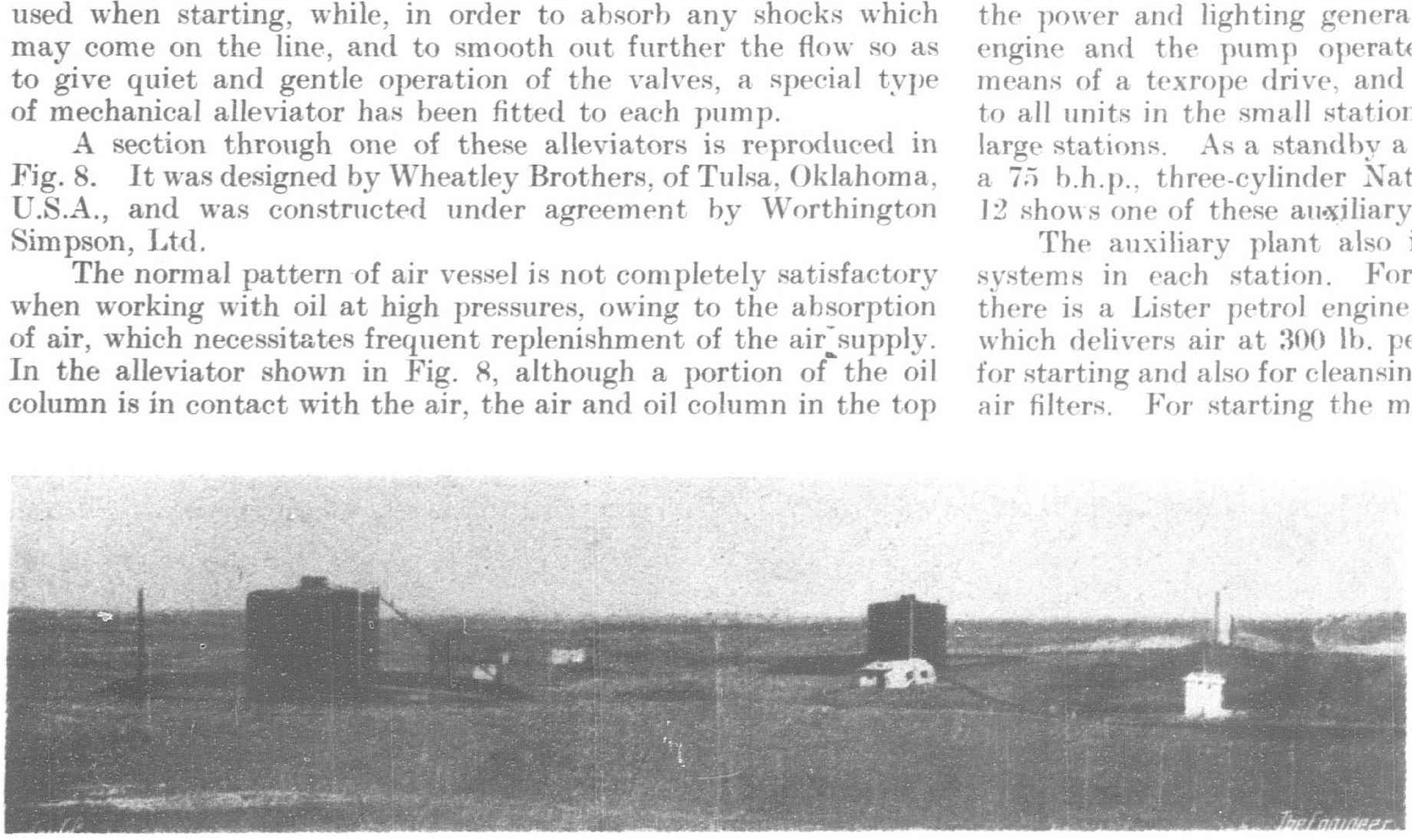


Fig. 14.—De-Gassing Station at Shurau

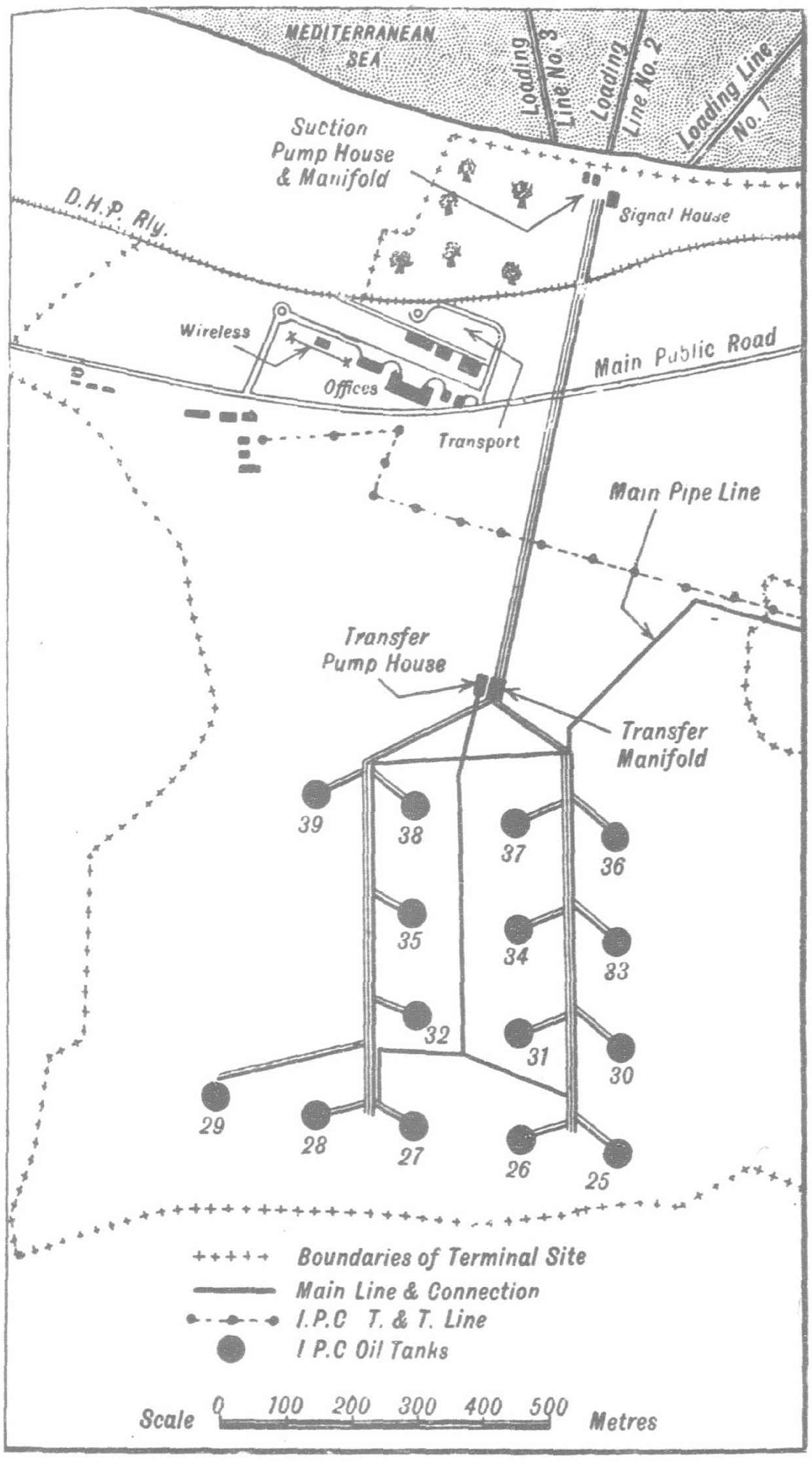


Fig. 15.—Plan of Tripoli Terminal

auxiliary equipment further includes three Worthington circulating pumps, both engine and motor driven. For the engine circuits a completely closed system is employed, the heated jacket water being cooled by passing through a heat exchanger, which is placed before the silencer in the exhaust pipe line, and in the suction connection to the individual main line pumps. In this way the main oil stream is used as a coolant, and at the same time the oil temperature being raised, the incoming oil is easier to pump. The circulating water pumps are both motor and engine driven, and are of the Worthington pattern, with outputs of 250 gallons for the small stations and 450 gallons for the large stations, delivered against a head of 69-ft., the water temperature being about 180 deg. Fah.

For fire service, heating water supply, and other uses, Worthington pumps are also used. Two interesting pumps within the pump house are the suction and salvage pumps, which are electrically driven through shafts extending through the fire wall. They are designed to deal with crude oil and water, and are available for draining the pipe line or tanks in case of fracture at any point. The larger pump has a designed output of 20,000 gallons and the smaller 4,000 Imperial gallons per hour with working pressures of 125 lb. and 250 lb. respectively. Each pump has very close clearances for dealing with high suction lifts at altitudes up to 2,500-ft. above sea level and at temperatures varying from 20 deg. to 130 deg. Fah., when pumping either oil or water. For reconditioning the lubricating oil a Hopkinson centrifugal purifier and washer, electrically driven, is used, and is designed to deal with 140 gallons per hour. The total capacity of the lubricating oil storage tanks is 2,300 gallons, and they are arranged above the ground, so that when draining off the crank case oil fresh oil can be conveniently run in by gravity, without having to shut down the engines or the pumps.

The fuel supply for the main engine is taken from the discharge pipe line and is stored in two elevated cone-bottomed fuel tanks—see Fig. 9. Each of these tanks has a capacity of 6,135 gallons, and feeds the supply system under gravity. The stations carry a very complete fire-fighting equipment, and in addition to the fire-proof walls there are numerous hydrants, also foam-generating equipment for producing fire-fighting fluid.

It now remains to make some reference to the de-gassing stations and the provisions for oil storage and transfer which have been made at the two Mediterranean terminal ports at Tripoli and Haifa. These terminals were officially opened on Saturday, January 19, and Tuesday, January 22, respectively, the ceremonies being appropriately performed by the Comte de Martel, French High Commissioner for Syria, and Sir Arthur Wauchope, the British High Commissioner for Palestine.

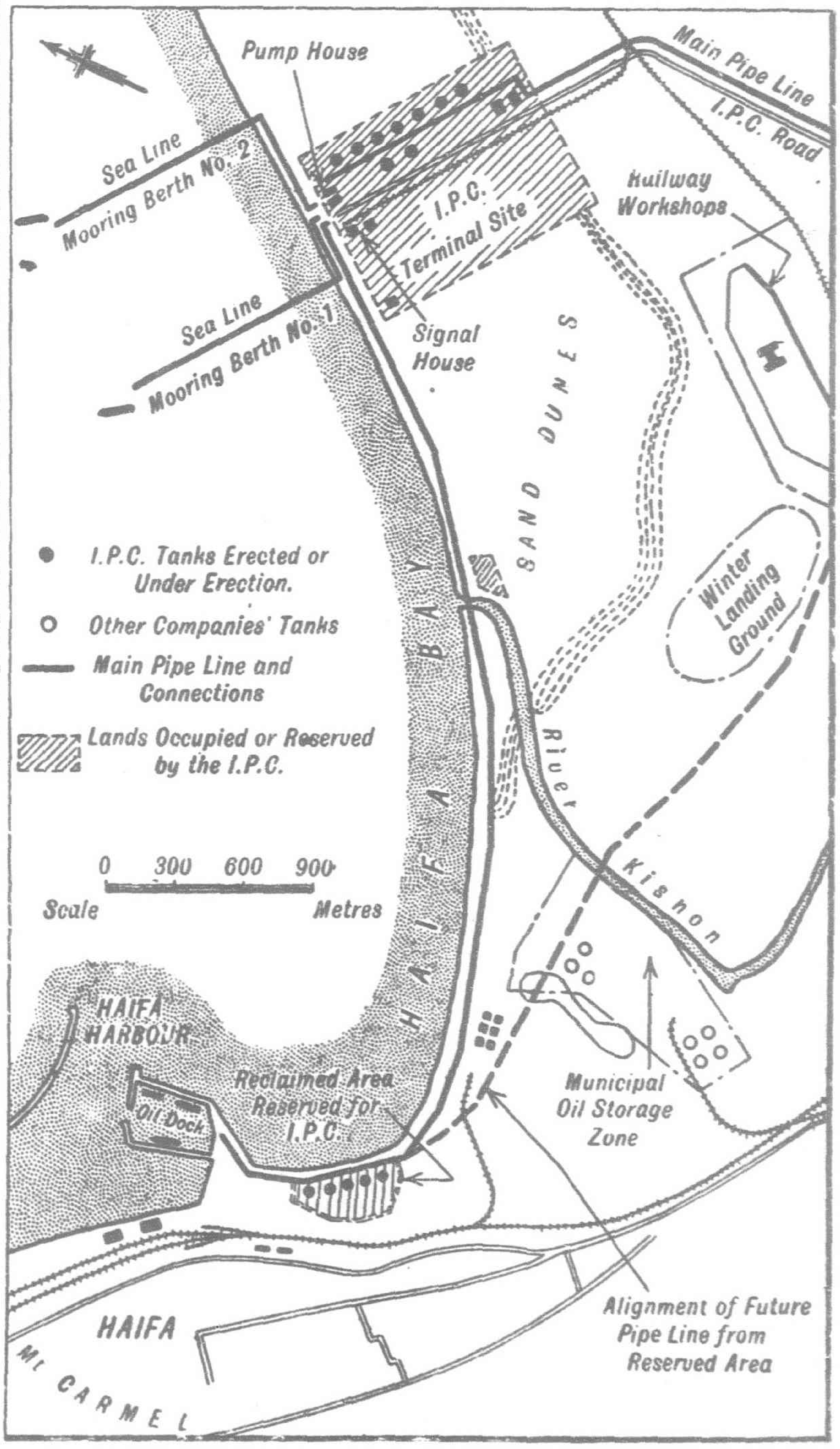
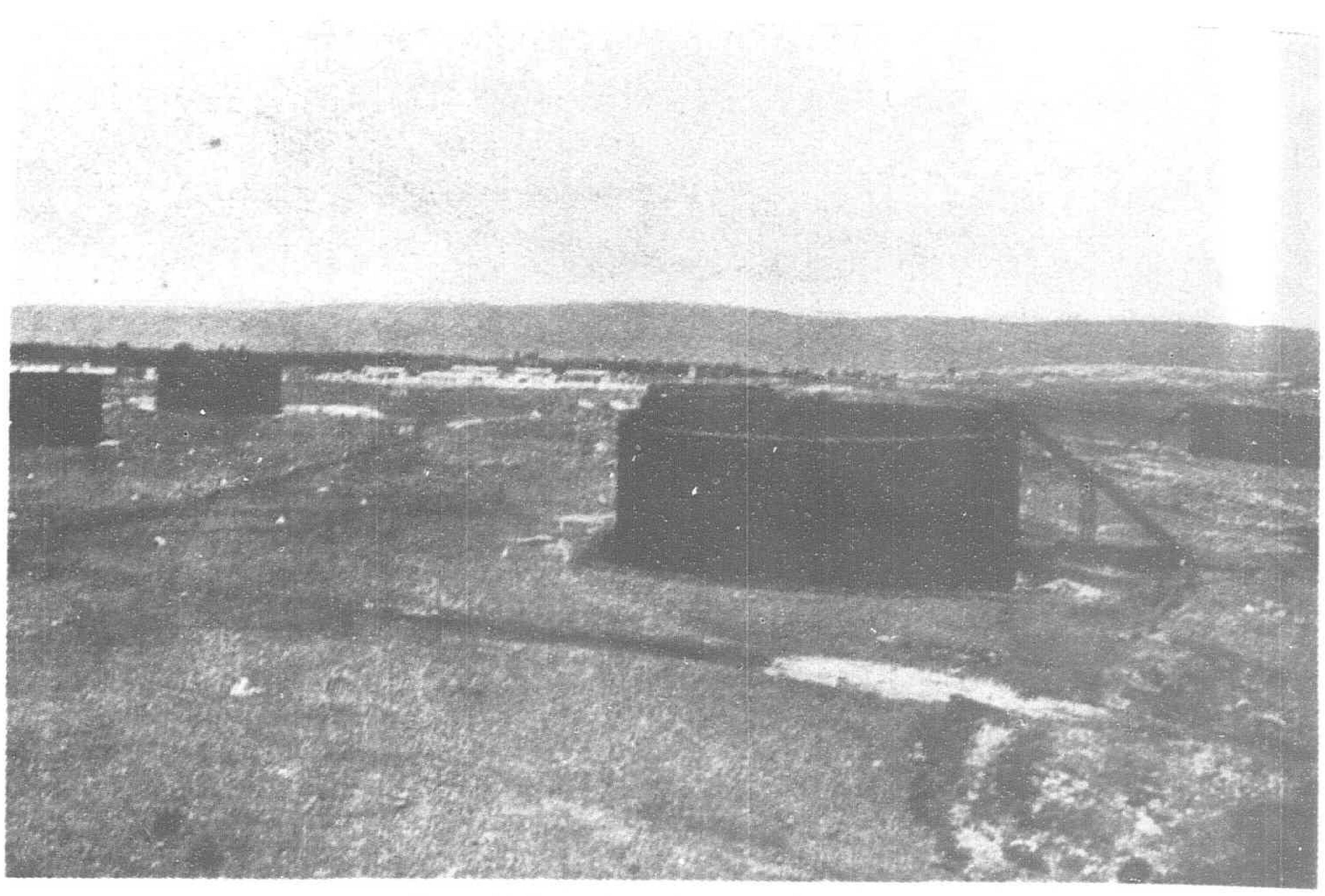


Fig. 16.—Plan of Haifa Terminal

De-gassing Equipment

The oil is received from the wells at a pressure of about 500 lb., and contains some forty times its own volume of gases, principally methane, ethane, and propane. Some method therefore had to be devised which would collect the oil from a given group of wells and deliver it practically free of gas to the first of the main pipe line stations. It was finally decided to erect three de-gassing stations at points ranging from two to four miles north-east and north-west of the K-1 station—see sketch map. At these stations oil is gathered from four wells at Shurau, five wells at Baba Gurgur, and five wells at Hanjira. At each station there are two vertical high-pressure separators, one being a duplicate and standby for the other. A view of these gas separators is reproduced in Fig. 13 ; while that reproduced in Fig. 14 shows the Shurau de-gassing station with the low-pressure reducing tanks. Oil is admitted to the high-pressure separator at a pressure of 50 lb. and the gas, which is freed by the lowering of the pressure from about 500 lb. to 50 lb., is piped off and burned at a distance. The pressure remaining in the oil after de-gassing is still high enough to force the oil into the low-pressure separator tanks, of which there are two at each de-gassing station. The gas which is evolved in these tanks is also carried off and burned, and the oil, now free from gas, is gravitated through large 14-in. diameter welded pipe lines to the main storage tanks at K-1 station. The construction of this pipe line involved the laying of some 9,500-ft. of burned and treated 12-in. line and about 39,000-ft. of 14-in. line. Any two of the three de-gassing stations are designed to handle the 3,000,000 gallons of oil per day which are required to keep the main pipe line in full operation. They deal with this duty with a wide margin of safety, which is provided by the duplication of separators and tanks at each of the three stations. The duplication of equipment also allows inspection and repairs to be carried out without shutting down, and it further facilitates the special experimental work which is now being carried through on the flow characteristics of the individual wells. The high-pressure separators were supplied by the National Tank Company, of Tulsa, Oklahoma, and the low-pressure flow tanks by the Motherwell Bridge and Engineering Company, Ltd., the valves being made by Cranes, Ltd., the 12-in. pipes by Stewarts and Lloyds, Ltd., and the 14-in. pipes by the National Tube Company, of Pittsburgh.



Tripoli Terminal looking Seaward

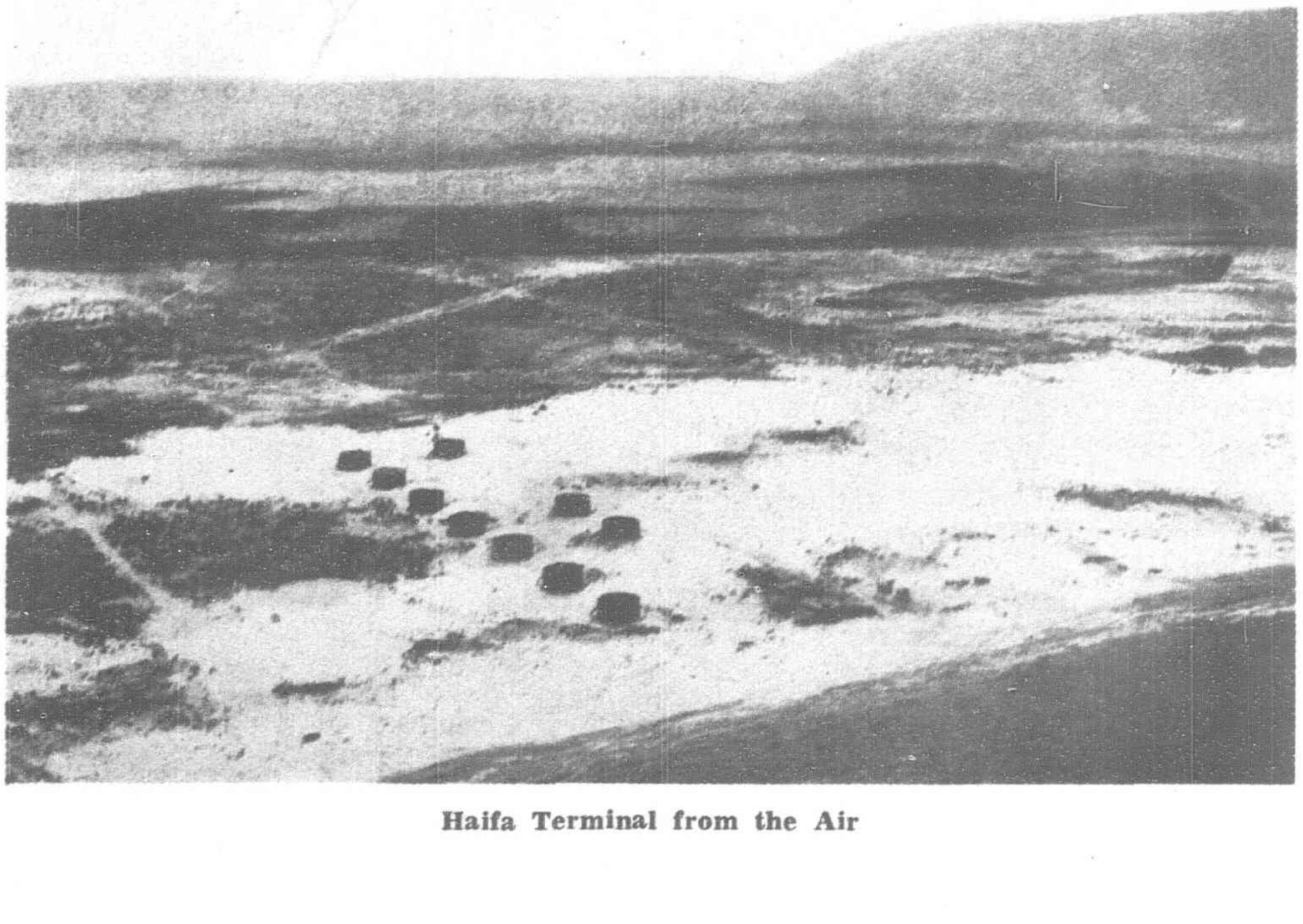
The Terminal Ports

We reproduce typical views of the Iraq Petroleum Company's two terminal ports on the Mediterranean coast. They include storage tanks of large enough reserve capacity to give immunity against loading delays, and well-planned arrangements for the loading of oil tankers. A general layout of the two stations is given in Figs. 15 and 16. Some variation in the physical characteristics of the two sites led to different methods being adopted at the two ports. At Tripoli the site stands on ground which rises inward from the sea, to a height of about 200-ft., and which, therefore, permits of a gravity loading scheme. On the other hand, there is here practically an open sea, with only the small shelter of a natural promontory, and that afforded by a small line of islands at the Tripoli Harbor, some three miles distant. At Haifa, as our illustrations show, the installation is erected in flat sand dune country, which gives no possibility of loading by gravity ; much use is, however, being made of the facilities afforded by the newly constructed Haifa Harbor. Features common to both installations are the delivery of oil to the tank farm direct from the last of the main line pumping stations, T-5 and H-4 respectively ; while a, in general, similar procedure has been followed in organization, sea-line loading methods, and in signalling arrangements, fire-fighting, and other equipment.

Tripoli Terminal Port

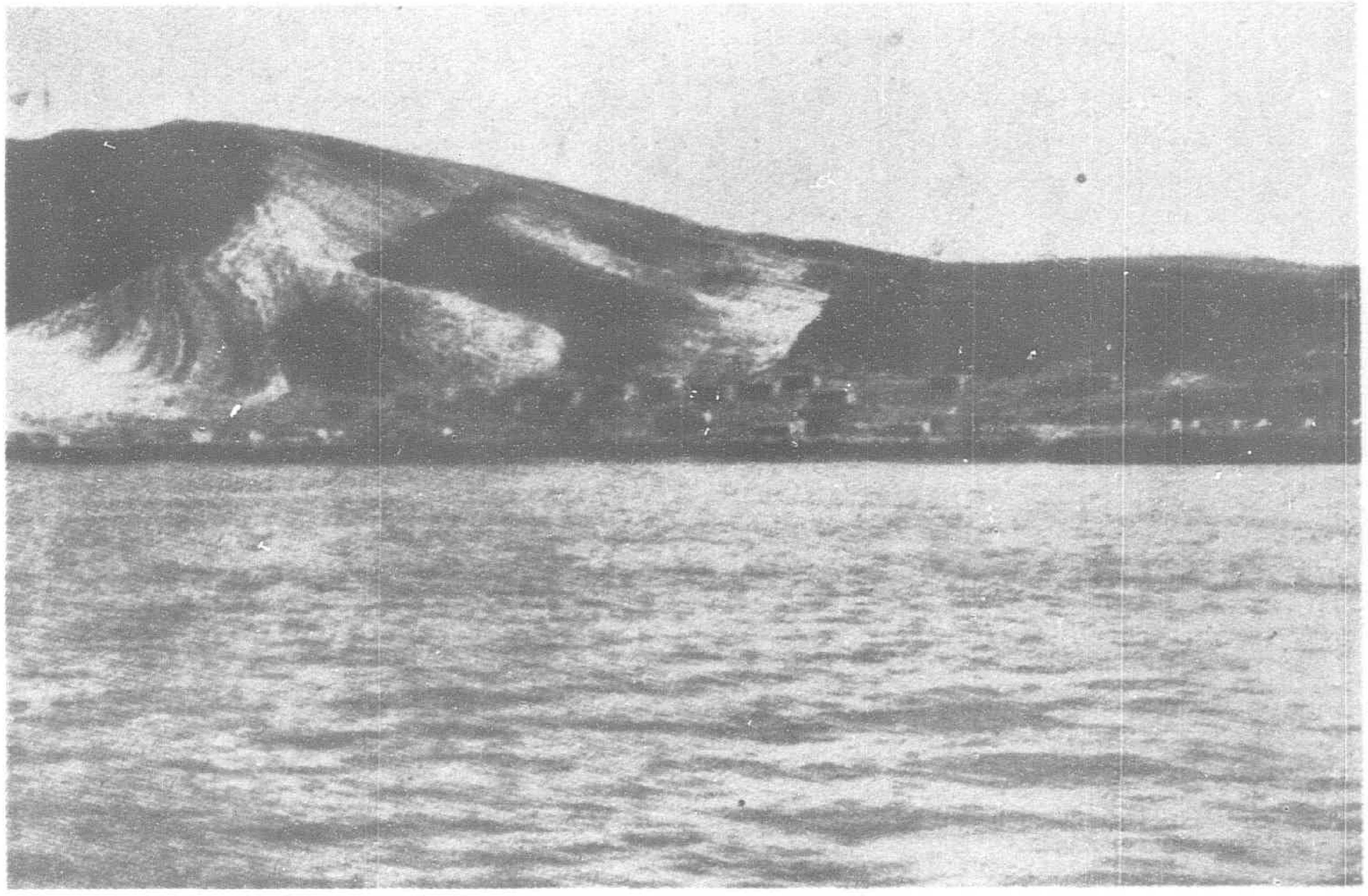
As indicated in Fig. 15, there are installed at Tripoli fifteen standard 93,000 barrel oil tanks, with Wiggins pontoon pattern floating roofs. These tanks were built and erected by Messrs. Worms et Cie., in collaboration with other French firms. They are arranged in four rows, that at the highest elevation containing five, the next two three each, and the lowest row four. Oil can, if it be desired, be transferred from tank to tank, or lower to higher, at a designed rate of about 500 tons per hour in order to facilitate quick loading. The pumping plant is arranged in the transfer pump house, which is situated just below the lowest row of tanks. The pumping plant comprises a Worthington-Simpson centrifugal pump driven by a 185 b.h.p. Laurence. Scott motor. A suction and salvage pump, for the purpose of draining the oil from the sea lines, should this ever be required, is also provided and this part of the plant is a duplicate of that provided at the main pumping stations. The plant provides for gravity loading from the highest tanks at 220-ft., at a theoretical rate of about 1,015 tons per hour, or 755 tons per hour from the lowest tanks.

The loading berths are situated at distances of 4,420-ft., 4,400-ft., and 5,470-ft. from the shore, and each is served by a double 12-in. pipe line, reduced to 10-in. at the end, so that a 10-in. flexible hose can be used. There is about 50-ft. of water at the loading berths, and in general an



Haifa Terminal from the Air

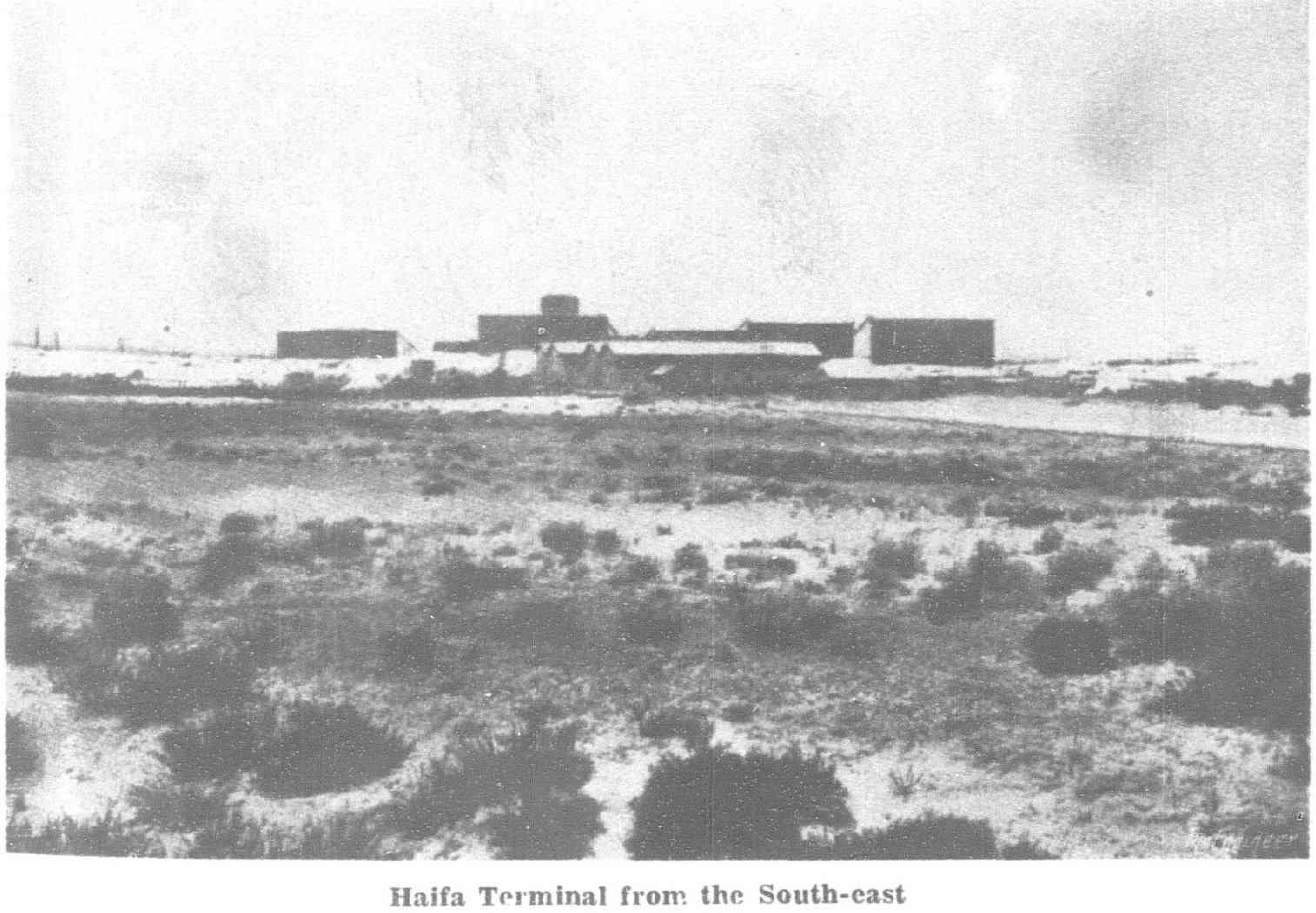
average of 1,000 tons per hour can be taken as the loading rate. The mooring equipment at both stations was supplied by Brown, Lenox, Ltd., and the loading hoses by the Boston Woven Hose and Rubber Company. The sea lines of piping were pulled out in May last at both terminal ports, the 9,000 ton Anglo-American oil tanker *Iroquois*, with a stern towing winch and cable, being chartered for that purpose. As is shown by Figs. 15 and 16, the sea lines at Tripoli run out fanwise, while at Haifa they run parallel to each other and about 2,600-ft. apart. At each port the ship to be loaded is moored at the loading berth by the ship's anchors and mooring buoys. For signalling between the ship and the shore, three methods are used—submarine telephone, Morse blinkers for night service, and a syren. Both ports are served by two 40-ft. Thornycroft launches, propelled by 120 b.h.p. oil engines, each of which carries two "whalers."



Tripoli Terminal from the Sea

Haifa Terminal Port

Turning now to the Haifa lay-out, it may be noted that the terminal port is connected to the Haifa-Acre railway and road by railway sidings and a road, an area of close upon 214 acres being enclosed by fencing. The ten 93,000 barrel tanks are of the same pattern as those installed at Tripoli, and were supplied by the Whessoe Foundry and Engineering Company, Ltd. They are arranged in two lines, one containing seven and the other three tanks. Water supply is obtained from local wells and three elevated 12,000 gallon tanks are provided. Power is obtained from the Palestine Electrical Corporation. Opposite the terminal, loading takes place at two berths, each 4,200-ft. from the shore, and each served by a 12-in. submarine pipe line divided at its seaward end into two 8-in. branches carrying 8-in. hoses. Loading is carried out at about 1,000 tons per hour. The necessary pressure for loading is furnished by three Worthington-Simpson centrifugal pumps driven by 500 b.h.p. Laurence, Scott motors. There is also a suction and salvage unit and a centrifugal booster pump for delivering oil to the storage tanks at the reclaimed area near to Haifa Harbor. At this point the oil dock is placed immediately west of the lee breakwater of the harbor, and is separated from the rest of the harbor by a jetty 1,485-ft. in length, parallel to the lee breakwater and a subsidiary jetty 485-ft. in length. The entrance between the jetty head, some 330-ft. in width, is enclosed by a movable steel boom. This gives a dock depth of 33-ft., which may later be deepened to 35-ft. Space exists for two ships of 500-ft. at the main jetty and for two more, if necessary, on the lee breakwater. An area of some three acres is reserved for the Iraq Petroleum Company's use, and other land for eventual tanks and pumping equipment. Provision has also been made at both terminal ports for future refining installations.



Haifa Terminal from the South-east

Electrical Equipment

Reference in our description has already been made to the pump motors supplied by Laurence, Scott and Electromotors, Ltd., but considerable electrical equipment was supplied by the General Electric Company, Ltd., of Witton and London. This included some 500 ceiling fans of the latest direct-current pattern for administrative offices, and fifty floodlights of a narrow-angle enclosed pattern with dust-tight sockets for the lighting of the pumping stations. In addition to Osram lamps, the firm supplied large quantities of rubber-insulated cable, together with ironclad switch-gear and other accessories. The cable was manufactured by the Pirelli-General Cable Works, Ltd., at Southampton, and comprises single-core, braided, twin lead-covered, and tough rubber-sheathed flexible cable and cords. All were supplied in 2,500-meg "Vicma" grade insulations, which was specially designed to meet the conditions experienced in Iraq.

In conclusion, we would express our indebtedness to the official description, entitled "The Construction of the Iraq-Mediterranean Pipe Line: A Tribute to the Men who Built It," which was issued by the Iraq Petroleum Company, Ltd., in October, 1934, and is a fascinating story of a great pioneer engineering work. We have also to thank the various contractors who have supplied information for our brief survey.

British Railway Experts in China

Brig.-Gen. Frederick Dawson Hammond, British railway expert, accompanied by Mr. L. J. L. Lean and Mr. F. J. M. Taylor, both of the Great Western Railway, have arrived in Nanking from England, in response to an invitation from the Chinese Government to examine and advise upon the Chinese railway system. They expect to be in China for approximately four months, the first two being devoted to the inspection of various railways, and the next two months to the work of compiling a report for the Government.

Engineering Notes

RAILWAYS

SZECHUAN'S ONLY RAILWAY.—Work has started on the third section of the Pei Chuan Railway in the Kiangpei district. This is Szechuan's only railway and it is about 150 miles in length.

NANKING-WUHU RAILWAY.—The Nanking-Wuhu Railway, 98 kilometers in length, is nearing completion. A trial run for freight traffic was made on April 1, while a regular service will be opened. Twelve locomotives purchased from the United States have arrived at Shanghai.

CHITA-URGA RAILWAY.—Construction of a railway between Chita, in the U.S.S.R., and Urga, in Outer Mongolia, has been decided upon by the Transport Commissariat of the Moscow Government. Provisions for the project are said to be contained in an agreement with Mongolia. The line between Chita and Urga, a distance of about 1,250 miles, will run via Kolulun. Materials for construction are already being forwarded from various stations on the Trans-Baikal Railway.

LIGHT TRAINS FOR JAPAN.—Spurred by the successes in the United States, France and Germany by stream lined, aluminium-alloy trains, the Japanese Ministry of Railways announced plans for the construction of similar conveyances. The trains will be driven by Diesel-electric power plant, that will give them a maximum speed of about 120 kilometers an hour, a high figure for Japan's narrow-gauge tracks. They will cost Y.90,000 each, and consist of three connecting coaches.

SHIPPING

WORK FOR BOXER FUNDS.—The Standing Committee of the Board of Trustees for the British Boxer Indemnity Refund has discussed a request of the Kiangsu Provincial Government for a loan of $1,000,000 for the purchase of motor fishing vessels; and the joint application of the Ministry of Industry and the Chekiang Provincial Government for a loan for the establishment of a paper mill at Wenchi. The Finance Sub-Committee of the Board examined the request by the Ministry of Railways for the remittance of a further sum of $1,250,000 for constructional expenses of the Chu-shao section of the Canton-Hankow Railway.

NEW NANKING WHARF.—Construction work on the new Nanking wharf (at Hsiakwan) of the Tientsin-Pukow Railway is nearing completion.

WHARF FOR WEIHAIWEI.—Plans for the construction of a wharf at Weihaiwei have been prepared. Mr. Hsu, Administrator of the territory, says that this is urgentlyrneeded for the development of the port; the cost is estimated at $800,000.

NEW WHARF OF LIENYUNKANG.—The engineering work for the No. 1 Wharf at the new port of Lienyunkang, the eastern terminus of the Lung-Hai Railway, in north-eastern Kiangsu, has been completed, according to a message received by the Lung-Hai Railway Administration.

GRAND CANAL IMPROVEMENT.—Plans to render the northern section of the Grand Canal navigable for large vessels in order to promote shipping in Shantung province, have been drawn up by the Provincial Department of Reconstruction. The scheme includes diverting of the waters of the Yellow River into the Grand Canal at Taochengpu and the construction of two water sluices and locks at Lintsing and Chouchiatien, in the Liaocheng district, to regulate the current. The total cost is estimated at over $200,000. The Provincial Department has instructed Messrs. Tsao Sui-chih and Kung Lin-yung to proceed to Nanking to submit the plans to the National Economic Council.

TELEPHONE SERVICE -
THE VITAL LINK!

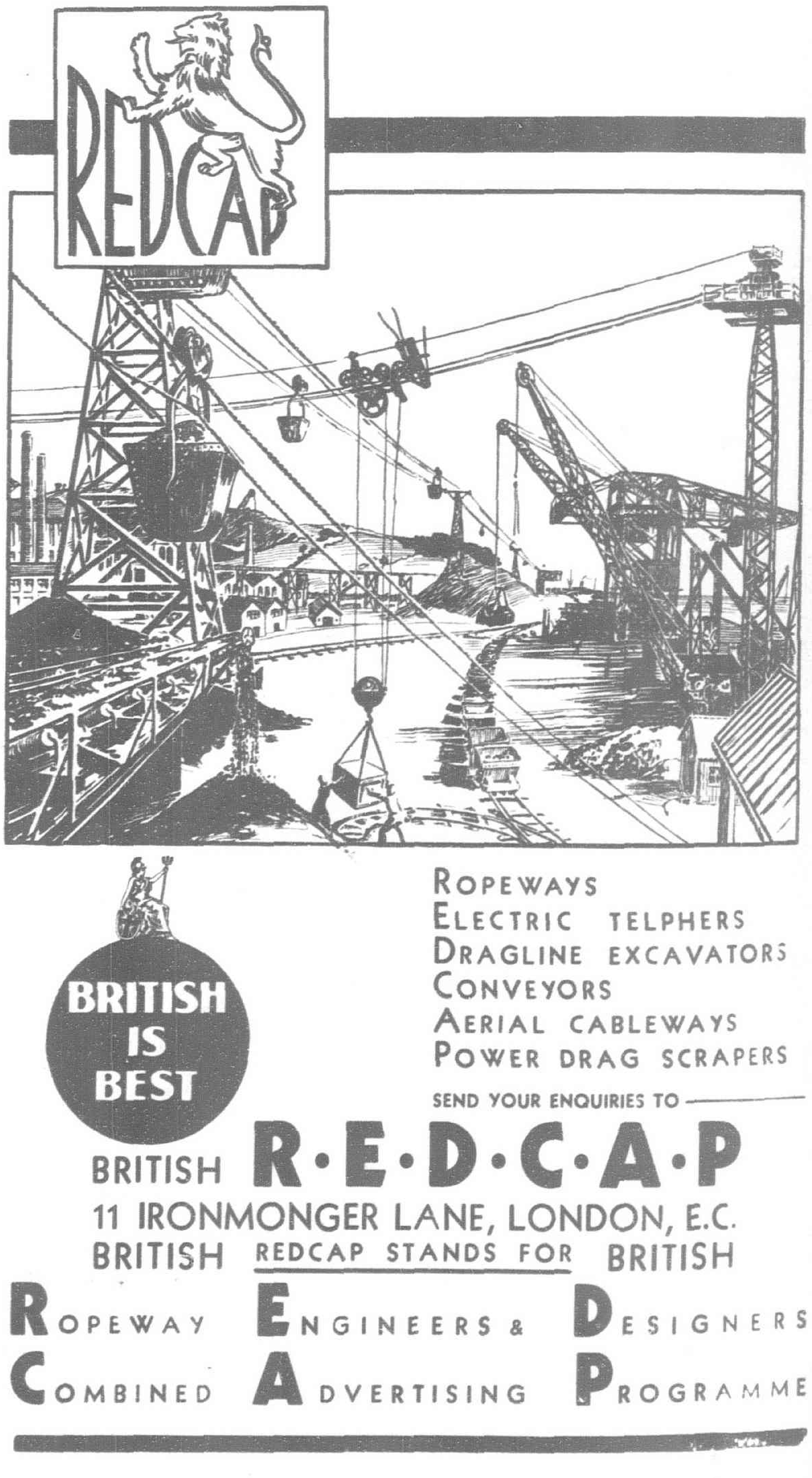
The commercial world of today relies more and more upon dependable telephone service.

Every plan for the service has adequate, yet economic provision to safeguard this dependability.

Any of our employees will be pleased to take your order, or consult the Business Office Now:—

TELEPHONE
94090

M.T. Mag 2.


ROPEWAYS
ELECTRIC TELPHERS
DRAGLINE EXCAVATORS
CONVEYORS
AERIAL CABLEWAYS
POWER DRAG SCRAPERS

SEND YOUR ENQUIRIES TO
BRITISH R·E·D·C·A·P
11 IRONMONGER LANE, LONDON, E.C.
BRITISH REDCAP STANDS FOR BRITISH

ROPEWAY ENGINEERS & DESIGNERS
COMBINED ADVERTISING PROGRAMME